The Welding Engineer

Founded by L. B. Mackenzie, 1916

NOVEMBER, 1926 — VOL. 11, No. 11

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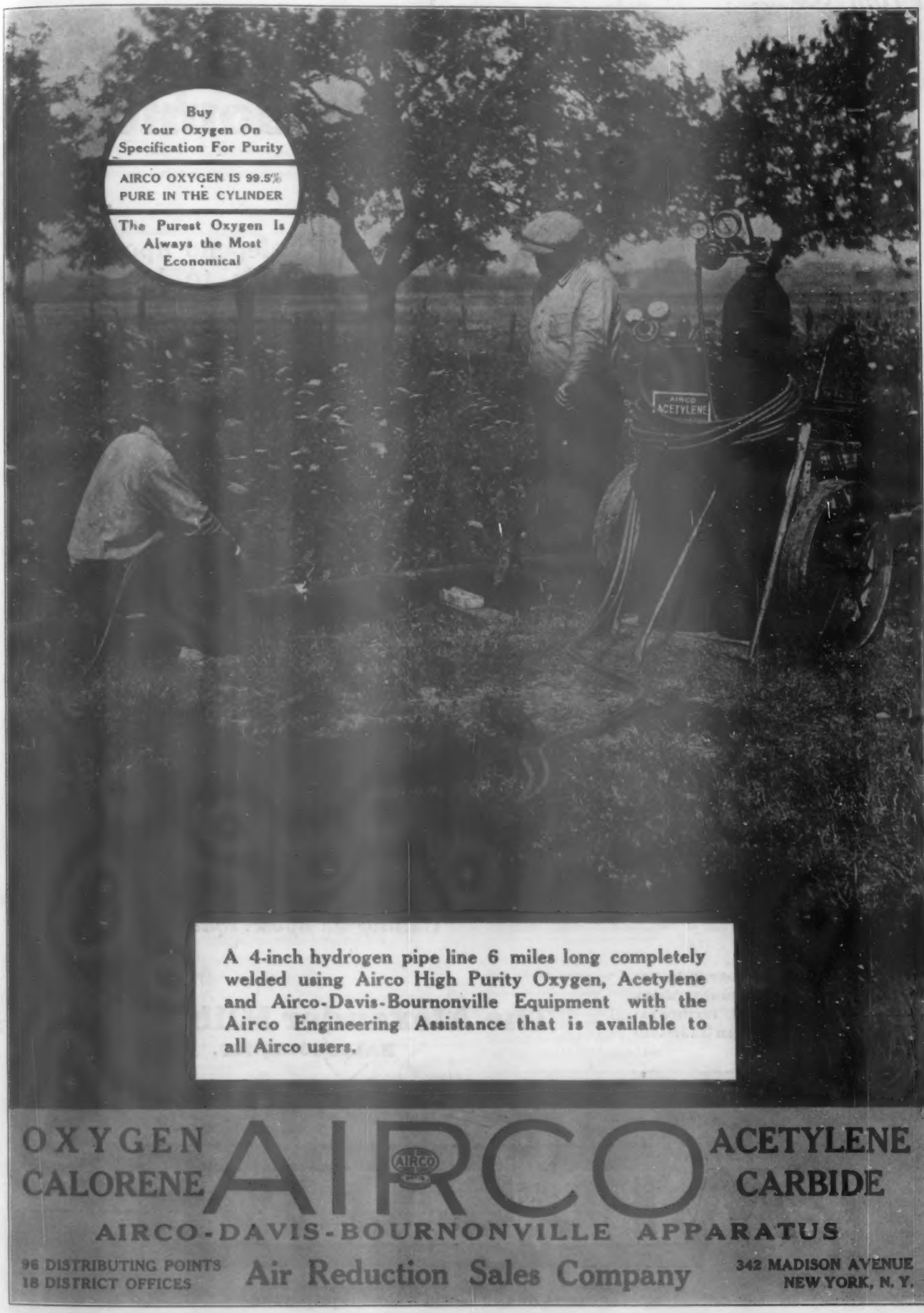
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The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 11 · November, 1926 · Number 11

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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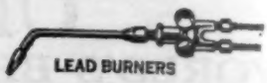
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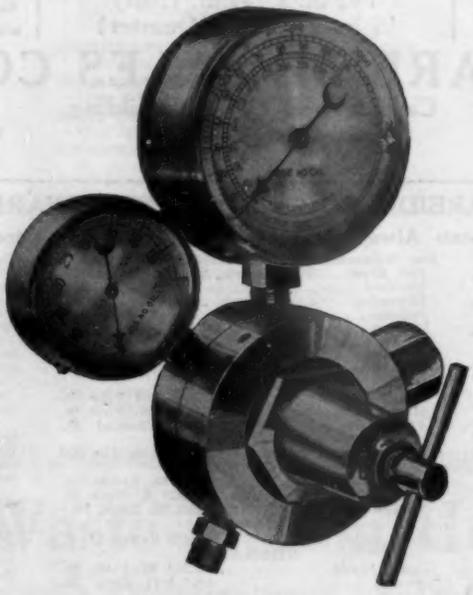

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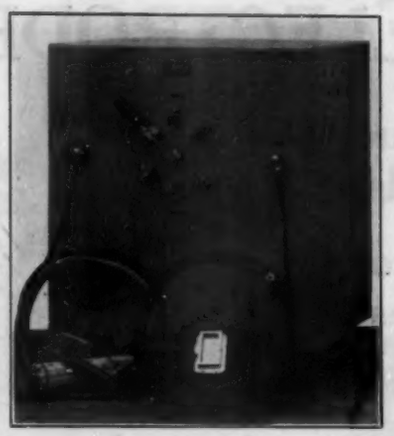

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Very Truly Yours
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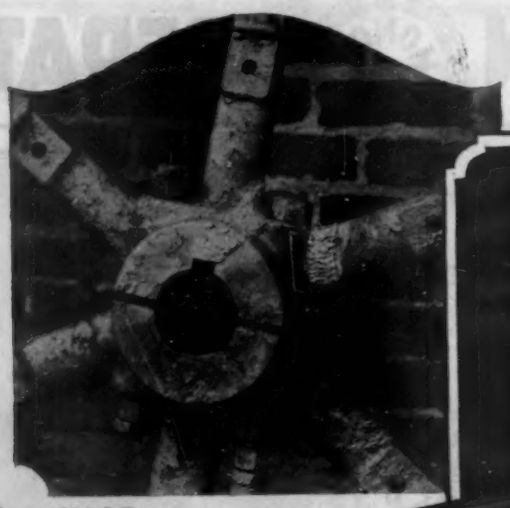

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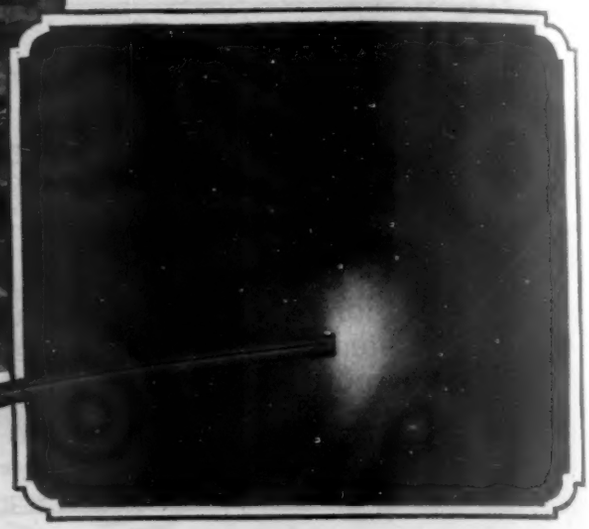

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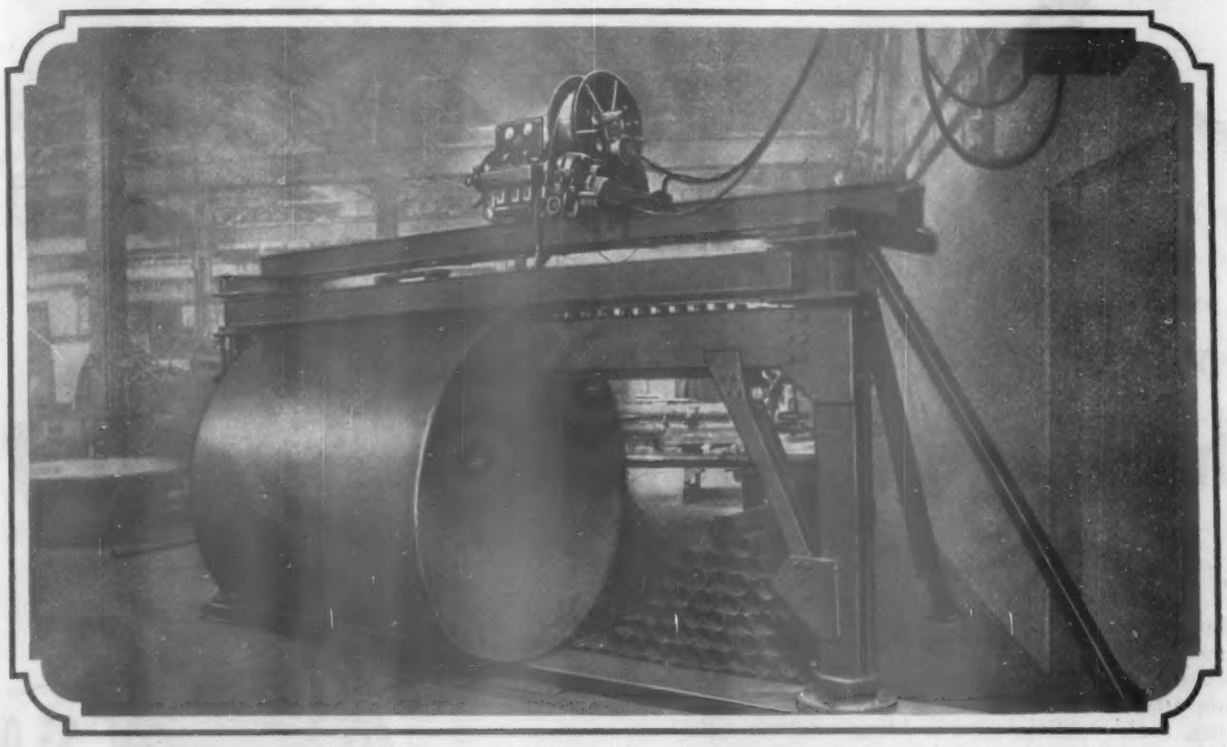

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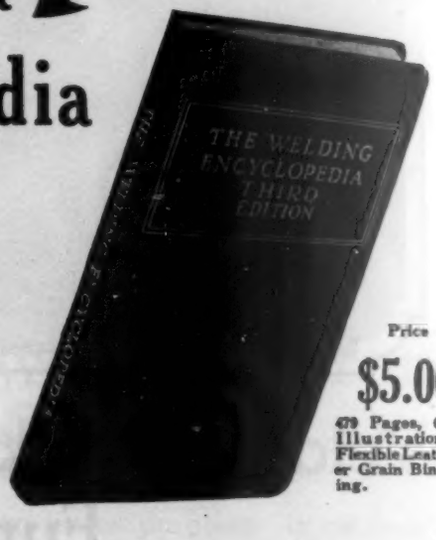

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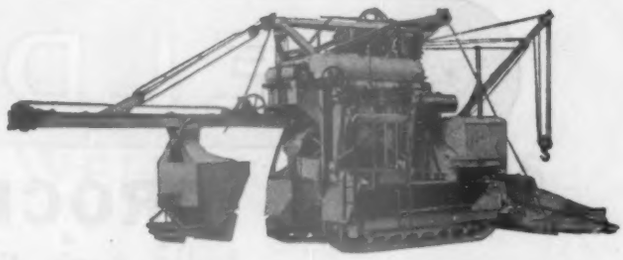

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They are designed on new principles. No complicated mechanism. Simple to operate. No moving parts to repair or adjust. Very economical, consuming a minimum amount of current. Very portable, weight of standard, 50 to 200 amp. welder only 290 lbs.

Temperature rise guaranteed not to exceed 40 degrees C. above surrounding temperature.

We manufacture machines of any capacity to suit your requirements.

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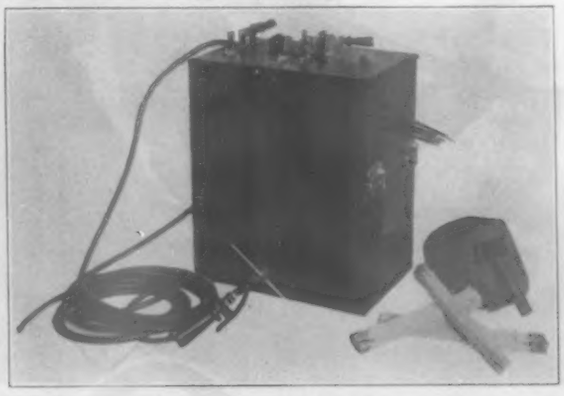

Bare or Coated Electrodes

Owen Electric Manufacturing Company
Fayetteville, North Carolina

Manufacturers of 37 different types of ARC WELDING MACHINES

UTILITY

A useful product is not just a happening but the result of years of patient, careful effort. Prest-O-Lite dissolved acetylene has been on the market for twenty-one years, with an ever-increasing volume of sales. That is proof of utility.

THE PREST-O-LITE COMPANY, INC.

Oxy-Acetylene Division

General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York
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31 Plants—85 Warehouses *22 District Sales Offices*

Prest-O-Lite

DISSOLVED ACETYLENE

EDITORIAL

The Many Sided Wage Question

A STANDARD scale of wages for welders would be practicable only if accompanied by a method standardizing the welders themselves. The question of wages is a ticklish one, yet it is often the case that on important work "many are called, but few are chosen." Many firms still advertise for welders when they don't care whether they get welders or not. They just want men to stick something together with the torch or the arc. Men can learn simple welding operations in a few minutes and honestly think they are welders. Why shouldn't they get as much pay as bricklayers? Did you ever hear of a bricklayer learning his trade in fifteen minutes? It should not take longer than that. All you have to do is throw down enough mortar to waste a little, put a brick on it, take a professional swat at it with the trowel, and continue the motion until the whistle blows. The hodcarrier does all the work. Low wages usually indicate a willingness to be satisfied with a poor quality of workmanship, or else that the work is of such a highly specialized nature that an actual knowledge of welding is of no consequence. Where good work is wanted, and good pay is offered, good men can usually be found for the job. And if a good welder keeps on looking he will usually find a job that will pay him what he is worth. Conditions are against any general solution of the wage question, though it keeps bobbing up.

Bronze Welding Deserves Its Popularity.

INCREASED sales of bronze welding rods, resulting from a carefully planned campaign of publicity, was an example used by one speaker at a recent convention of men interested in industrial advertising subjects. Now, with all due gratitude to the speaker for his generous testimony on behalf of the business paper, it is no more than fair to prospective advertisers that attention be directed to the real merit of the product advertised. For bronze welding, welding with bronze, brazing, or whatever you may choose to call it, is here to stay. Many welders with "twenty years experience" have tried it and pronounced it a dud, only to be shown up by men without experience who were willing to follow instructions. The process has grown not only as a repair process but also as a production process, and its importance to the industry lies largely in its applications which are practically exclusive; that is, jobs which offer discouraging obstacles to all other methods. The educational work which has built a market for the bronze rod has also furnished the industrial world with an efficient tool.

Try and Do It

OF ALL the weird suggestions that have been made for the benefit of the welding industry, the most interesting one is that manufacturers of competing products get together and agree to stop claiming to be able to solve welding difficulties by using particular products or processes. As a matter of fact, such claims are, in general, perfectly sound. Many problems have more than one solution, and if the buyer is confused it is his own fault. If welding will help him, it behooves him to become familiar enough with it so that he can select a solution from a group. Lacking the ability to do that, it is hard to see how he could use welding intelligently after having picked his process or equipment at random.

A Recent Development in Welding Equipment.

FOUR years ago an enterprising firm of sales agents stumbled on the welding industry and asked for suggestions for a new product which would fill a real need. They were advised to get together an arc welding machine, gas engine driven, an air compressor, and a suitable truck, and market the whole combination as a unit. They made an investigation and turned the proposition down, and it appears that they made a mistake. The demand has been there all the time, and is so keenly felt that within a few months at least three such units have been announced. Any good sized welding shop could have testified to the necessity for all the parts of such a combination, but it took a long while to get combinations together for the market. It is an interesting looking piece of equipment when you look it over, a tool that will perform a great variety of operations on sick or injured pieces of metal, an ambulance equipped with an operating room, an outfit that is prepared for everything. Such an outfit has for a long time appeared to be a logical development.

Why Not a Flexible Educational Program?

EVERY survey made of the place which welding has in our national educational program shows that each institution has a distinctly individual treatment of the subject, with the exception of those who ignore it entirely. That situation is not at all discouraging, even if it is unsatisfactory. It is suggestive, however, of the good that might come from an organized educational program which would take into account the facilities of different institutions, and assist them in using to the best advantage the time available for the consideration of welding.

How Big Is the Oil Industry?

WHAT are the future possibilities for the welding industry? Suppose we measure them by taking just one commodity and considering how much that commodity depends on welding. The oil industry is one of many large customers of welding. We drill for oil with welded tools; we store the crude oil in welded tanks; from the tanks it runs through welded pipe lines to the refinery; here it is refined in welded stills; welded tank cars carry it to distributing centers; again it is stored in welded tanks; welded tank trucks carry it to the filling station; the station handles it in welded containers! and delivers it into a welded automobile. Yet this great industry called "Oil" is using only a fraction of the amount of welding it could use. And you would have to multiply this possibility by a large factor to get a picture of the total future possibilities for welding.

Tested to Destruction.

IT IS probably true that it is necessary to test a welded structure to destruction in order to be sure just how strong it is. We have been reminded of that old chestnut while reading the sales literature of organizations interested in the sale of various kinds of building materials since the great disaster in Florida. This literature pictures what happened to all other types of buildings. We get the impression that every kind of modern construction was "tested to destruction" when the wind got strong enough. But they all overlooked the baby of the building industry. The child was saved. There is no published record of any all-welded building in the devastated area that was harmed in the least.

37 Plants and 105 Warehouses spell protection

WHEN YOU order oxygen, you may come in contact only with the Linde district office and with the warehouse from which it is shipped. But you know that the oxygen will reach you without delay.

It does not matter whether the order is for a single cylinder or a carload. It makes no difference whether every customer in your district wants oxygen on that particular day. There are 37 Linde plants and 105 Linde warehouses in the country, a total of 142 sources of supply, and their resources can be mobilized quickly and easily at any point.

This means that your oxygen supply will never fail, even in times of severe stress.

THE LINDE AIR PRODUCTS COMPANY

Manufacturers of oxygen, nitrogen, pyrogen, argon and neon
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37 *Plants* • 105 *Warehouses*

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LINDE OXYGEN

Gas Welding Stainless Steels*

Brittleness Has Been Overcome by the Addition of 8 Per Cent Nickel and 2 Per Cent Silicon to Parent Metal

By S. M. Norwood†

THERE are many difficulties inherent in the welding of alloys containing more than 10 per cent chromium. The most serious problems are those of brittleness in the weld and in the base metal adjacent to the weld; a brittleness that cannot be relieved even by heat treatment in alloys containing 20 per cent or more of chromium. The author has overcome these obstacles by the addition of 8 per cent nickel to high-chromium alloys. The objection of diminished corrosion resistance to sulfur products, generally accompanying the addition of nickel, has been removed by an addition of 2 per cent silicon. The presence of manganese in percentages equal to the silicon improves the welding characteristics of the alloy.

One of the most important problems in the chemical industry is the design of equipment capable of withstanding the extreme conditions frequently encountered. In recent years marked advances have been made in the development of alloys resistant to pressure, temperature and corrosion, because it has been found that improved efficiencies in many processes can be attained only through higher pressures and temperatures, the latter often exceeding red heat. Among such alloys, those containing 10 per cent or more of chromium have become particularly prominent. Of the numerous mechanical problems to be solved in the practical application of these alloys, welding must be considered as among the most pressing. Since the general properties of these chromium alloys have been discussed elsewhere, they will not be considered in this paper except in their relation to welding.

Noteworthy improvements have been made in the welding of these alloys, but new compositions and new uses will give rise to new problems in this field. It has been found possible to weld these materials with entire satisfaction for certain uses, but this operation has not been quite so successful in applications where exceptionally high strength and ductility are desired, as in the welding of pressure vessels and apparatus which must withstand severe vibratory stresses. Gas welding has been most commonly employed, and usually with a reducing flame, that is, with an excess of acetylene. Such a flame makes welding much easier for these particular alloys, but it has the disadvantage of introducing carbon into the weld, resulting in hardness, lack of dutility, and machining difficulties. Electric welding is also being successfully applied to these alloys.

The welding of high-chromium alloys gives rise to infusible oxides, which are difficult to float to the surface of the weld; unless removed, however, they constitute points of weakness. Only recently, fluxes have been developed which operate satisfactorily in slagging off these oxides and protecting the metal from excessive oxidation during welding. These fluxes permit the use of a neutral flame in gas welding, while they improve electric welding by yielding a clean, dense, deposit.

In those alloys consisting chiefly of chromium and iron, certain other difficulties become apparent after a weld is completed, notably a lack of ductility in the weld metal and in that portion of the plate metal adjacent to the weld. In alloys containing not over approximately 20 per cent of chromium, this brittleness can be remedied to some extent by heat treatment, but this method may not always be applicable, because of the size or other features of the construction. Moreover, heat treatment is not effective in relieving weld brittleness in alloys containing more than about 20 per cent of chromium.

Long experimentation in this direction has led to the conclusion that the remedy is to be found not so much in a marked departure from the present method of welding as in an improvement in the composition of the alloy. The addition of around eight per cent of nickel to high-chromium alloys has been found beneficial, since it refines the grain and improves the dutility and shock resistance, while at the same time preventing the development of brittleness after welding. It also improves slightly the welding qualities of the alloy. Nickel, however, has a tendency to diminish the resistance of the alloy to corrosion by certain media, such as sulfur, sulfur dioxide, and other gases containing sulfur.

This objection has been offset by increasing the silicon in the alloy to about two per cent. For example, under the action of moist sulfur dioxide at 1,000° C. for 48 hours, the loss of weight per unit area by a 25 per cent chrome iron, containing 10 per cent nickel and two per cent silicon, was almost precisely one-half the loss suffered by a plain chrome iron of similar chromium contents. Under the same conditions, a direct comparison of two 25 per cent chrome irons, each containing 10 per cent nickel, showed that the loss by the one containing two per cent silicon was again almost exactly one-half of that lost by the alloy carrying only 0.5 per cent silicon. The addition of nickel, when accompanied by silicon, is found to have no adverse effect on the resistance of the alloy to dilute nitric acid and to oxidation at high temperature; in fact, the effect appears to be slightly in the opposite direction.

It has also been found that if the percentage of manganese is made approximately equal to that of silicon, a flux-covered rod becomes unnecessary, since the products of oxidation are self-slagging. The above-mentioned additions to the high-chromium alloys, especially to those containing more than about 20 per cent of chromium, have been found to solve most of the difficulties which have been encountered in welding, while affording a composition easy to weld and having difficulty in the welded article without heat treatment. Results have been obtained on welded coupons, ground flush, in which the elongation in two inches containing the weld has been as high as 10 per cent, together with a yield point of 50,000 pounds and an ultimate strength of 80,000 pounds per square inch.

The break almost invariably occurs in the weld, in contrast with the usual experience when dealing with plain chrome iron, which usually breaks in the adjacent plate metal embrittled by the welding treatment. Such results must be considered very favorable, when compared with the almost negligible elongation observed in welds on compositions containing normal amounts of manganese or silicon, but little or no nickel. Under the bending test, welds in one-fourth-inch plates have been bent 100° to 110° before the first cracking is observed. The plate metals used in the above-mentioned welding tests (all ranging below 0.20 per cent carbon, al-

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* *Paper presented at the Fiftieth General Meeting of the American Electrochemical Society, Washington, D. C., Oct. 7, 1926.*

† *Union Carbide and Carbon Research Laboratories, Inc.*

though carbon up to 0.5 per cent introduces no difficulty) show yield points of about 20,000, and ultimate strengths of 90,000 to 100,000 pounds per square inch, with elongations of 35 to 40 percent in two inches. Machining of the test specimens involves no particular complications, and the cast alloys are as easily machined as those which have been forged or rolled.

High-chromium alloys for corrosion resistance are a comparatively recent development; nevertheless their applications have already reached beyond the expectation of the most sanguine. This unusually rapid commercial adoption of the alloys has required them to meet demands which had not been entirely foreseen, particularly in respect to ease of fabrication, under which head welding is an obviously important factor.

STRUCTURAL STEEL MAN TELLS ENGINEERS ABOUT WELDING AT THE WEEKLY MEETING OF THE ENGINEERS' CLUB AT OMAHA

On October 27th Mr. Fred H. Marsh, Sales Manager, Paxton & Vierling Iron Works, Omaha, Nebraska, read a paper on the future of structural steel before the Engineers' Club of Omaha. The subject matter of the paper was devoted to the possibilities for making future savings in the fabrication of structural steel through the application of welding to the joints. The paper pointed out the savings which could come from the elimination of a great many details in the layout work, to the elimination of templates and many of the punching and riveting operations in the shop. In the field work, it was pointed out that the erection crews would be reduced in number and that there would be a material saving in the weight of steel, due to the simplified design made possible by welding. These and other advantages of welding structural steel were pointed out, and then a number of cases were cited of erection operations in which welding had been used with noticeably satisfactory results. Particular attention was paid to recent tests which have been made on a great variety of welded designs preliminary to the construction of a five-story all-welded building.

There were forty members of the Omaha Engineers' Club present at the meeting, among them being representatives of power companies and the engineering departments of railroads. Considerable interest was shown in the paper, and Mr. Marsh passed around a collection of photographs and printed articles to illustrate the nature of the work which is now being done.

AUSTRALIAN WELDER ON WORLD TOUR

For several months Mr. A. L. West, Managing Director, West's Welding Works, Limited, Sydney, Australia, has been traveling in Europe and America in the interests of his company, making investigations of the applications of the different welding processes in repair and production work. He has also given some attention to a new device called the "Triune" metal cutter. This device is an attachment which can be put on any type of welding torch to make a cutting torch out of it. Special tips are provided for cutting rivets, removing steel risers, or cutting cast iron. It is simple to operate with either high pressure or low pressure welding torches. The cutting tips are all of the one-piece type and are self-adjusting. No definite arrangements for the sale of the device have yet been announced, but it is Mr. West's desire to arrange for a sale of the manufacturing rights to an American firm making oxy-acetylene torches.

CARTERS LIMITED USES FOUR PAGE NEWSPAPER AD

One of the most elaborate advertisements which has ever been printed by a firm in the welding supply business was recently used by Carters Limited of Hamilton, Ontario, in the Hamilton Spectator of Tuesday, October 12th. This firm prepared an advertisement which completely filled four pages of the newspaper. It described the growth of the organization from the establishment of the business in 1916, by William Carter, who, with his son, Wilfred Carter, conducted the business in very limited quarters and floor space. Today this enterprise represents an investment of approximately a quarter of a million dollars, occupies floor space exceeding 25,000 square feet and has a staff of thirty highly skilled specialty workmen. The welding department is an important feature of the service which they render to the public. They are equipped to handle repair jobs of every size and also for production welding. The firm is to be congratulated on the splendid progress they have made and on the fine example which they have set to others who make a business of the art of welding.

WELDING EXHIBITS AT RAILWAY ELECTRICAL SHOW

The Railway Electrical Supply Manufacturers' Association held an exhibit in connection with the Sixteenth Annual Convention of the Association of Railway Electrical Engineers, which was held in the Hotel Sherman, Chicago, October 26 to 29. The General Electric Company exhibited arc welding equipment. The C. H. Hollup Corporation exhibited a complete line of gas and electric welding wire, oxy-acetylene welding equipment, and accessories. The U. S. Light & Heat Corporation exhibited welding apparatus and samples of electric welding. The Westinghouse Electric & Manufacturing Company exhibited samples of arc welds in structural steel.

NEW PUBLICATION ON ARC WELDING OF STRUCTURAL STEEL

The Westinghouse Electric & Manufacturing Company have just issued a 31-page publication, S. P. 1767, "The Arc Welding of Structural Steel," that is very opportune, in view of the increased interest and activity in the arc-welding of steel buildings.

The first part of this publication deals with the arc welded buildings at the East Pittsburgh Works of the Westinghouse company. The succeeding sections describe the erection methods, the test and inspection of arc welds, and the metallurgy of welding. The publication is completed with a discussion of the testing of actual joints and a very detailed description of the results of the tests conducted at the Carnegie Institute of Technology.

This special publication, which also includes a description of the single and multiple operator arc welding equipment, the gas engine driven and the portable belted generator equipment and the Westinghouse Auto Arc, may be obtained from any of the district offices of the Westinghouse company or from the Publicity Department at East Pittsburgh, Pa.

CORRECTION

In the October issue of *The Welding Engineer* an account was given of the recent meeting of the C. G. M. A., in which Mr. T. H. Markillie was listed as being connected with the Linde Air Products Company. It appears that the listing was incorrectly made in preparing the copy for publication, as Mr. Markillie is Director of Sales for the United Lead Company, 111 Broadway, New York.

Production Welding

The Proprietor of a New England Shop Makes a Regular Business of Fabricating Useful Articles by Arc Welding

UNDER the able management of Mr. Paul B. Covey, the Manchester Engineering and Welding Co., of Manchester, N. H., is making rapid strides toward unusual success in the commercial welding field. The story of this shop and its work presents a picture of the possibilities ahead of the modern job welding shop, and recalls Mr. R. E. Kinkead's excellent inspirational article, "Gold in the Welding Process," which appeared in a recent issue of *The Welding Engineer*.

The company, which is owned solely by Mr. Covey, started operation on the first of March of this year at 449 Hayward Street, Manchester, with the intention of using the process of electric welding in connection with structural steel fabrication and as a side issue to use the welding machine for such repair work on machinery, automobiles, castings, etc., as might be picked up in the territory.

Mr. Covey is a graduate civil engineer of Columbia University in the class of 1913, and has specialized in building since, having worked for the American Bridge Company, Carnegie Steel Company, Baltimore & Ohio Railroad Company, New England Structural Steel Company of East Everett, Mass., and the F. P. Lyons Iron Works and the New Hampshire Structural Steel Company, both of Manchester, and during this time has become familiar with structural steel fabrication.

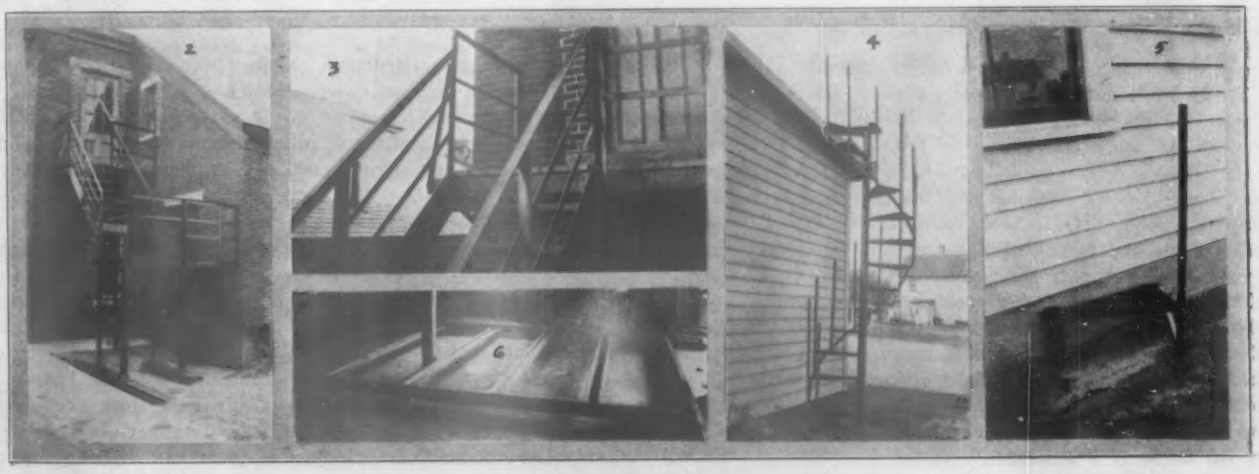
During the last few years he has had called to his attention through news items and editorials, the great strides which electric welding has been making and it seemed only logical to him that there would be a great field for this process in the line of work in which he was specializing. So he took off a month and a half from his work, went to the Schenectady plant of the General Electric Company and studied quite thoroughly the art of electric welding as applied to building, before starting this company. This company, by the way, is the only company within a considerable number of miles which does electric welding on a commercial basis. The shop is equipped with a G-E WD 12 welding outfit. Just how the possibilities in this direction are being realized in actual practice, can best be made plain be reference to the photographs reproduced here.

No. 1 gives an exterior view of the shop and shows the ease with which they repair broken machinery. The truck has just backed up to one of the shop windows and they run our leads through the windows and then do the work on the truck. Smaller jobs are handled on a table which was fabricated for use in the shop. All joints of the support for this table are electric welded.

Photo No. 2 shows a fire escape which they erected in Nashua, New Hampshire, all shop work being electric welded and No. 3 shows a detailed view at the upper level of this fire escape. In connection with this job it might be stated that the run of stairs from platform to platform with the exception of the rail was welded into one unit, the bars of the treads being welded to end bars and the completed tread being welded top and bottom to the stringers. Also, all necessary connection angles for fastening this run of stairs were welded to the stringers as well. The members making up each section of railiing were welded together in the shop and the sections shipped in units.

Mr. Covey's Welding Shop.

The only bolts used on the job were those necessary for connecting the sections together in the field. Photo No. 3 shows the four bolts connecting each stringer to the platform at the top and also the bolts used to connect the railing at the joints of the sections. The railings for the platforms were made in large units all welded together with small clips welded on and these clips were bolted to the supporting frame in the field.



Some Welded Fire Escape and Stair Case Jobs.

The advantage of this particular type of construction is that it is not necessary where the fire escapes are shipped in large units, as in this case, for the steel contractor to do the erection work where there is a general contractor on the job. The usual custom, of course, is for the fire escape to be shipped in a

knocked down condition and the steel contractor sends men to the job to erect the fire escape. This is expensive, especially when the job might be some miles away from the shop but is a necessary expense, as the usual contractor is not experienced in the assembling of such a multitude of parts as is found in usual shipment of fire escapes.

With the method Mr. Covey employs any contractor with a reasonable amount of experience can erect the material, because the units are large and can be easily numbered and an erection diagram can be furnished which can make it very simple for any one to erect in the field.

In Photo No. 4 we show a set of spiral stairs which was fabricated for a florist at Brattleboro, Vermont, and Photo No. 5 gives a little larger view of one section of this fire escape. In this particular case the customer did not care whether the tread was open or closed and so they used the regular fire escape type of construction in the formation of this tread, and built same up just as they did for fabricating a fire escape tread, and welded the end securely to a section of pipe.

They also welded on a piece of angle which was used for a post for the railing, also made of small angle iron. These sections, as made and shown in Photo No. 5 were then slid down over a central pipe and where one section lapped over the section below, provision was made for field bolting these sections together. Of course, the pieces of railing between the angle pieces had to be bolted together in the field. This made a very simple and neat spiral stairway.

Photo No. 7 shows a checkered plate door, 3′ wide and 6′ long with a 4″ channel frame and 2″ removable tee bar in the center. All parts of this door, including the handles, hinges, etc., were welded together, the door being one unit when shipped. The tee in the center was made removable so that a clear opening 3′ wide and 6′ long might be obtained. This door was also furnished for the florist at Brattleboro, Vermont.

In Photo No. 6 is shown one of several steel frames for metal sash which was furnished for the Central Maine Power Company at Lewiston, Maine. These frames were roughly 18′ wide by 20′ high and the individual sections were made up of plates, angles and bars. Of course, owing to its size, it was necessary to provide connections for field bolting together the separate sections making up the frame but the individual pieces of metal making up each section were welded together in the shop.

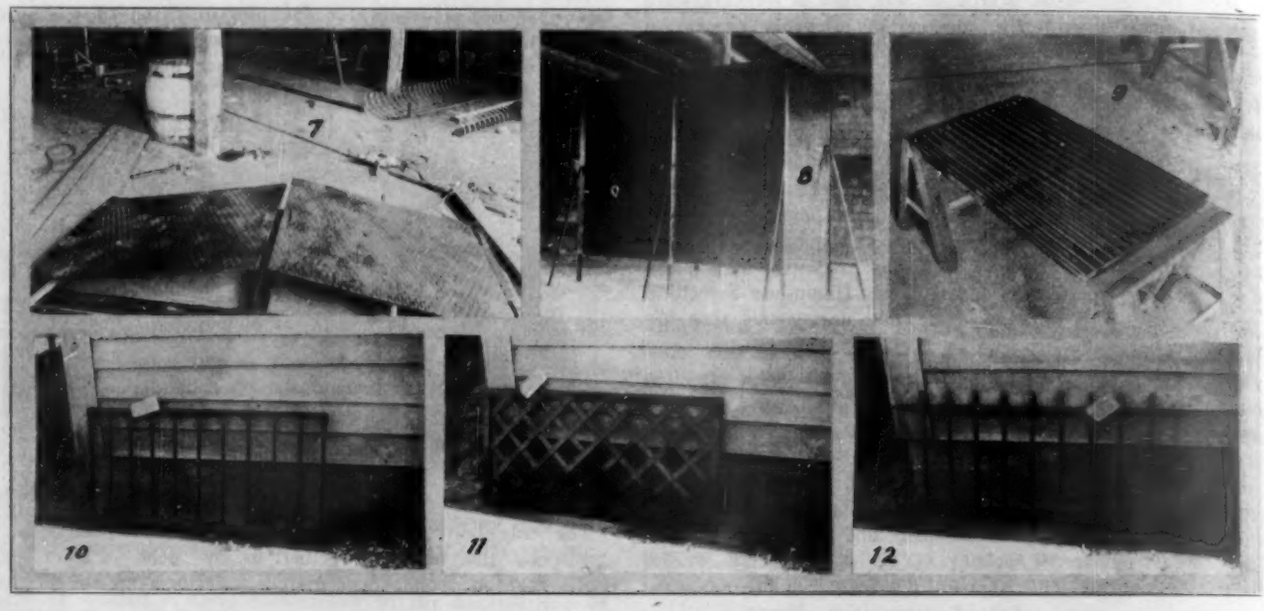
Photo No. 8 shows an iron screen which was made for use in the shop. This is 7′ high and 6′ long, 1/16″ plate being used to cover the frame work. All joints were electric welded.

Photo No. 9 shows an area grating which was fabricated 100% electric welded.

In Photos 10, 11, and 12 are shown window guards which were all 100% electric welded.

It might be stated that they have also worked up an ornamental fence similar to the details of the guard in Photo No. 1

So much for the building end of the work. As far as the repair work is concerned, Mr. Covey states that they have experienced no great difficulty in the class of work, with the exception of one case of aluminum welding which was brought to the shop and on which they did not have any success at all. All other work has been easy and satisfactorily done. Some job welders look upon a production welding contract as a "lucky break," incidental to the regular business of repair work. Mr. Covey has gone about his work the other way around, making production work his principal study.



Welding Possibilities in Doors, Screens, Gratings and Gates.

LOAD TABLES FOR STEEL CONSTRUCTION

A new handbook containing allowable load tables for use in designing steel construction, has just been issued by the American Institute of Steel Construction.

The tables are based on an 18,000 pound per square inch stress on extreme fibres of rolled shapes subjected to bending strains and a maximum 15,000 pound fibre stress in columns, reduced by formula. These stresses are now allowable in over sixty cities and state building codes in the United States and Canada. With a minor exception, they are recommended by the Building Code Committee of the Department of Commerce and are approved by a joint committee of the American Society of Civil Engineers and the American Institute of Steel Construction, Inc.

The form of the tables of allowable loads for beams and columns is an improvement over any heretofore produced in that each table includes all of the data pertaining to each structural shape and each type of plain and built-up columns. This form obviates the necessity of the user referring to different tables, as is necessary in the handbooks heretofore published.

This first edition of "Steel Construction Allowable Load Tables" is a preliminary publication. When certain sections, now being developed, are on the market and their characteristics determined, they will be included in the second and complete edition. However, for such shapes as are now on the market, this book is a most valuable aid to the designer of steel construction. The handbook is distributed by the American Institute of Steel Construction, Inc., 285 Madison Avenue, New York City.

Metallography for the Welder

Familiarity With This Science Will Enable the Welder to Understand Significant Features of Scientific Papers on Welding

By J. B. Green*

AS the art of Fusion Welding develops, competition forces those who practice it to know more and more concerning what are beginning to be recognized as the complex phenomena involved. In the very early days, the pure trickster got by. He could break up a piece of cast iron, take other bits of cast iron fuse them into the crack with a chemists' oxy-hydrogen blow pipe and advertise that he had accomplished the impossible by welding cast iron. He attracted a lot of attention because blacksmiths' hammer welding was then the only sort known and it is a fact that the blacksmith can not hammer weld cast iron. If the trickster's broken casting was stuck together well enough to bear handling, he did more than anyone else at the time. Competition, however, soon drove him to the necessity of doing more than merely stick the pieces together. They also had to have strength. Then they had to be joined cheaply. Later they often had to be machinable and so on. Welding development is proceeding much like the rolling snowball, so that the leader of yesterday often finds himself buried today. Welders have rated themselves and been rated by the number of years they have practiced the art. It is more to the point now to rate them by how up to date they are in the art. The time is not far distant when there will be more development in Fusion Welding in one single year than in all the previous years the art has been practiced. To keep abreast of the times, the welder must be sufficiently familiar with the language of physics, chemistry, metallurgy, etc. to at least read understandingly technical articles dealing with welding development.

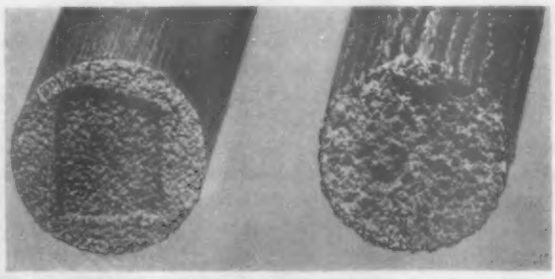


Fig. 1.
Macrostructure of low carbon steel revealed by etching in hydrochloric acid. Magnification 6 diameters. A good hand glass gives this much magnification.

Metallography is a science that is contributing a great deal to the development of welding and this article is written for those who desire to know a little something about it. Metallography is the science of mapping metals. A more dignified definition might read the science dealing with metal structure. As most such structures are made up of units too small to be seen with the naked eye, a microscope is indispensable to the metallographist. What is seen through the microscope is called the micro-structure while what can be seen without magnification is spoken of as the macro-structure. In Figure 1 is shown the macrostructure and Figure 2 the microstructure of some pieces of steel welding rod. In both cases, the steel is surfaced off smooth and etched to accomplish what is referred to as bringing out the structure. The metallographist in developing his art has probably paid as much attention to this preparation of specimens as anything else. Just as in welding, the proper preparation of the parent metal, selection of filler rod, adjustment of torch flame or current, etc. must first be accomplished or a worthless weld results, so in metallography the polishing, etching, etc. are fundamental prerequisites to useful results.

*Research Department— Chicago Steel & Wire Company.

There are probably as many ways of preparing a metallographic specimen as there are a weld. Like welding, some are suited to one sort of work and some to other sorts. Also as in welding, there are often differences of opinion as to the method best suited to particular kinds of work. In general, the specimen is first smoothed off with a file or emery which is reasonably flat. Following this, finer and finer abrasives are used, then polishing media such as rouge, etc. until the desired polish and freedom from scratches is obtained. The specimen is then usually etched. The commonest method of doing this consists in dipping or otherwise wetting the polished surface with an alcoholic solution of nitric acid. Picric acid, ammonium persulphate and many other chemicals are also used. Whatever the etching means, its action must be such as to affect differently the various units making up the metallic structure, thus rendering them visible through giving them different appearances.

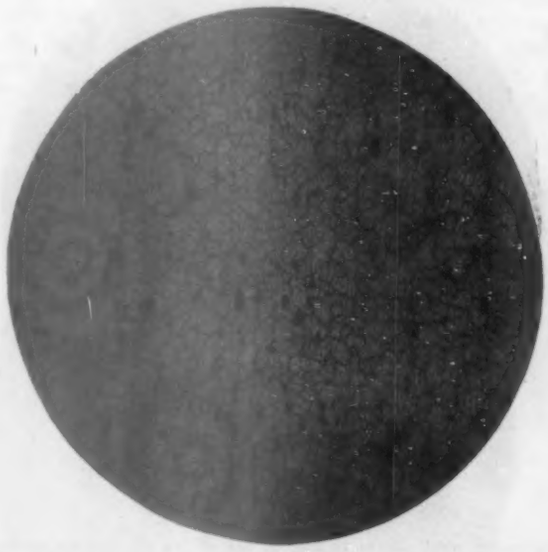


Fig. 2.
Microstructure of low carbon steel showing ferrite or iron crystals plainly with carbon in the form of carbide scattered between the crystals and appearing as black specks. Magnification 100 diameters.

Metals are essentially crystaline but the individual crystal is too small to be seen with the naked eye. Aggregations of these crystals form the grains which are visible without a microscope and a piece of broken metal exhibiting a granular structure is often wrongly spoken of as crystalized. Such metal has merely broken along grain boundaries. It was crystalline from the time it was first made. When, for any reason, comparatively large areas of a metal section differ widely enough from other comparatively large areas to have etching bring out this difference, the macro or visible structure is usually worthy of study. On examining the rod shown at the left in Fig. 1, it is quite evident the center must be different from the outside. The rod on the right in the same picture seems to be pretty much the same throughout, the etching acid having merely pitted it more or less uniformly. These are pictures of a $\frac{1}{4}$" welding rod so it is easy to judge that the illustration is magnified only a very few diameters, a scant six, to be exact. Nothing really is brought out by such low magnification that can not as readily be seen with the naked eye so this is called the macro-structure.

Just as the quality of welding rods, in so far as it depends on metallic structure, can often readily be determined without the aid of a microscope, so can the quality of welds. Any welder with a reasonably smooth file and a bottle of acid can study the macro-structure of his filler rods and welds. It is often surprising how much can be learned and how much good can be accomplished in selecting materials and deciding welders' technique by this simple method.

The true crystalline structure seldom becomes visible below about 40 diameters magnification. This means that the end of a $\frac{1}{16}$" filler rod must be enlarged to 7½ inches diameter. Enlarging the diameter 40 times means that the area is enlarged by a square of 40 or 1600 times. Fig. 2 shows a piece of steel at 100 diameters

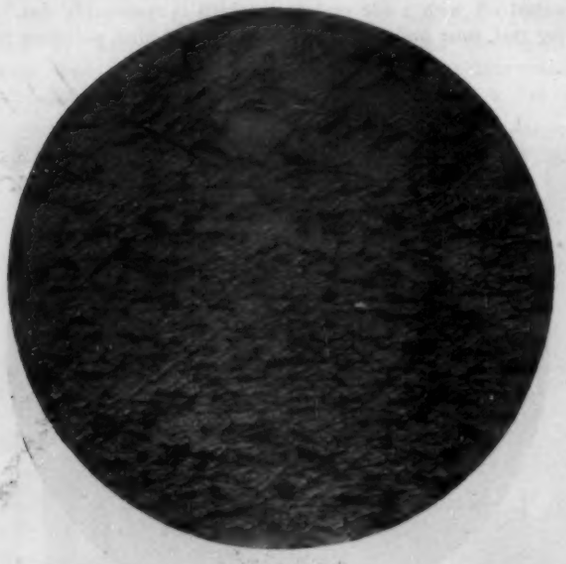


Fig. 3.

Low carbon steel similar to Fig. 2, but at 180 diameters magnification. The carbide specks or patches are a little larger. This specimen was not as carefully prepared or polished as the one shown in Fig. 2. Scratch marks prevent seeing the true crystal structure as readily.

while Fig. 3 shows a similar piece at 180 diameters. The first five photographs with this article are of the same or similar pieces of mild steel. It is interesting to study them to note how different the structure appears at different magnifications, starting with Fig. 1 at 6 diameters, then Fig. 2 at 100, Fig. 3 at 180, Fig. 4 at 1500 and finally Fig. 5 at 5200 diameters. In Fig. 2 the true crystalline structure of metal is propably best shown while in Fig. 4, the microscope was focused on the black carbide patches and the crystal boundaries are scarcely discernable. In the first four pictures, the light used was thrown on the specimen at right angles to the surface being photographed. This is called flat lighting. In Fig. 5, however, it struck the specimen obliquely which is called conical lighting. This gives the picture a three dimension effect because shadows are introduced and these produce a more natural appearance to the man who is not in the habit of studying photomicrographs.

It is both unnecessary and hopeless for the welder to study photomicrographs with the idea of interpreting them correctly. To do this is a life work. All the welder needs to do it to become sufficiently familiar with metallography to understand the expert's interpretation. The welder should know something of how a metallographic specimen is prepared and studied, something of the significance of magnifications, and also something concerning the general constitution of metals. He should, in conncetion with this, know the meaning of a few of the technical terms commonly used.

After a specimen has been prepared, it is mounted in the microscope for study. Many things can be seen when actually looking through the microscope which do not show in the photomicrograph. Anyone who has taken snap shots with a camera can readily appreciate this. Our own pictures are usually more interesting than those taken by others. Why? Because our own picture is not only a picture but a sort of memorandum of the surrounding country or objects not possible to include in the photographs, what happened the day it was taken and the like. To everyone else, it means what is in the picture but nothing more. We see our own pictures unconsciously in their natural colors, while to others they are black and white. Still, we can talk much better of the scene or the incident if we can illustrate it with a snap shot than if we are limited to words only. So the metallographist uses the photomicrograph. If we do not know something about how a photograph is taken, what a mountain, a tree, a river, a boat or a house looks like and what it represents, it is easy to imagine how difficult is the task of the speaker who is trying to tell of the picture. The metallographist is daily giving the welder much useful information but this information only becomes valuable as it is understood. The metallographist cannot be asked to clutter up his writing with a lot of elementary explanation. Much of the mystery of photomicrographs will disappear if they are examined as we would a friend's snap shots that he brings back from a trip. There are just two differences that must be kept in mind. One is the absence of shadows or the flat lighting characteristic of practically all photomicrographs and the other has to do with magnification. In the snap shot, the largest mountain may cover only a square inch of the picture. In the photomicrograph, the specimen is like the picture of the mountain and what we see has been enlarged to the proportions of the mountain itself. From a distance, a mountain appears like a mass of shadow on the horizon. As we draw nearer, the shadows begin to take form, some becoming rock slides, others forests and so on. The closer we approach the greater the detail. This is analogous to changing the magnification when viewing a specimen through the microscope. Carbide in steel is probably the most important item to study so this will be used to illustrate the effect of magnification. In Fig. 2, the carbide appears as small black specks, and in Fig. 3 these look much the same only larger. In Fig. 4 these specks have been magnified until they are large black blotches. Fig 5 is an enlargement of a small section of one of the black blotches of Fig. 4.

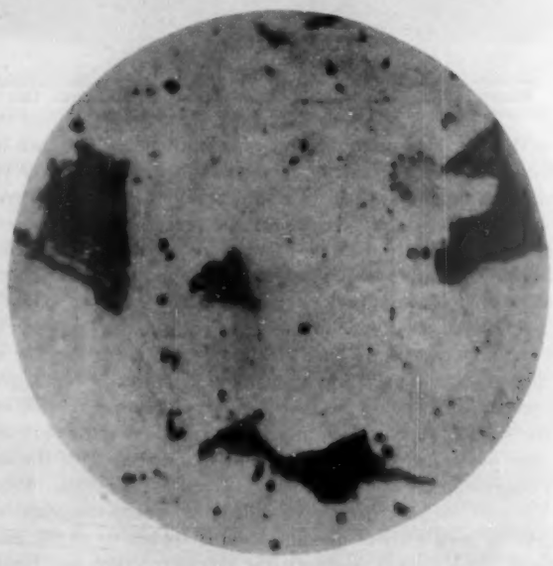


Fig. 4.

Low carbon steel similar to that shown in others figures, but at 1500 diameters magnification. The carbide specks here have been magnified to such an extent they appear as large black patches.

This last picture, Fig. 5, deserves considerable comment as it serves to illustrate the significance of magnification, and furnishes the opportunity of defining what is called "Pearlite", a term that welders will have to become especially familiar with in the near future. In the first place, few people have had the privilege of examining a picture taken at over 5000 diameters magnification. This is almost exactly equal to enlarging a single square foot to a

square mile. The surface covered by what is shown in the picture is in fact much less than the point of a fine needle. Most photomicrographs are taken at 100 to 200 diameters and only occasionally are powers as high as 1000 used.

Pearlite got its name because this structure so frequently found in carbon steels resembles mother-of-pearl when viewed under the microscope. The iridescence is due to the fact that light is broken up into prismatic colors when it falls on a surface composed of

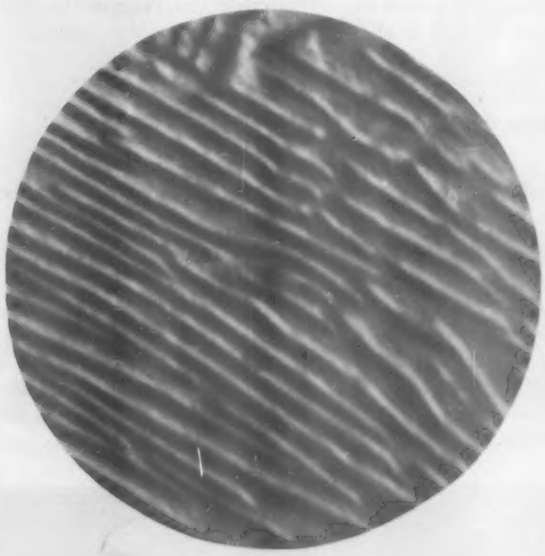


Fig. 5.

A small part of one of the black carbide patches of Fig. 3 magnified to 5200 diameters. This reveals the true structure of what is called "Pearlite" as explained in the text.

very fine lines spaced close together. Such surfaces are called diffraction gratings and are used in spectroscopic analysis, especially by astronomers in determining the chemical composition of the start. Pearl shell is made up of extremely thin layers the edges of which usually appear on the inside. Light striking this shell surface is broken up in the prismatic colors and this produces the iridescent effect. The constituent pearlite as found in steel is made up of very thin alternate layers or lamellae of carbide usually called

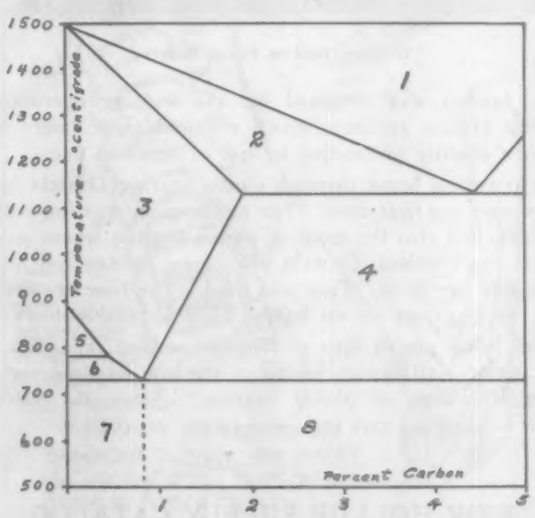


Fig. 6.

Iron-Carbon Equilibrium Diagram.
This is divided into various parts which are numbered for reference. The stable or equilibrium condition of carbon steels and cast irons of the various carbon contents indicated are as follows for each part: 1—Molten Iron with the carbon dissolved in it. 2—Mixture of molten Iron and solid austinite. 3—Austinite. 4—Mixture of Austinite and Cementite. 5—Mixture of Beta and Gamma Iron usually written as Greek letters. 6—Mixture of Gamma and Alpha iron. 7—Ferrite (pure iron) and Pearlite. 8—Cementite and Pearlite.

cementite, a chemical compound of carbon and iron or manganese, and pure iron which is referred to as ferrite. Seldom has a photomicrograph been published that shows this lamellar structure of pearlite as does the one in Fig. 5. Probably in a subsequent article the significance of pearlite as it affects the quality of welding rod will be discussed and some of the mystery regarding difference in working characteristics of rods of the same analysis explained.

Many terms used by metallographists have been explained in the preceding praagraphs. Quite a few terms refer to the condition of carbon in steel. This condition not only varies with the quantity of carbon but also with the temperature. It so happens that a certain time interval is required for one condition to change to another when temperature is the cause. This fact furnishes the basis for heat treatment. Generally the higher the temperature the quicker the change. Changes take place at room temperatures usually so slowly, probably thousands of years being required, that we say for practical purposes they do not take place at all. Whenever there is a tendency to change, the metal is said to be in unstable equilibrium but when no such tendency exists it is in

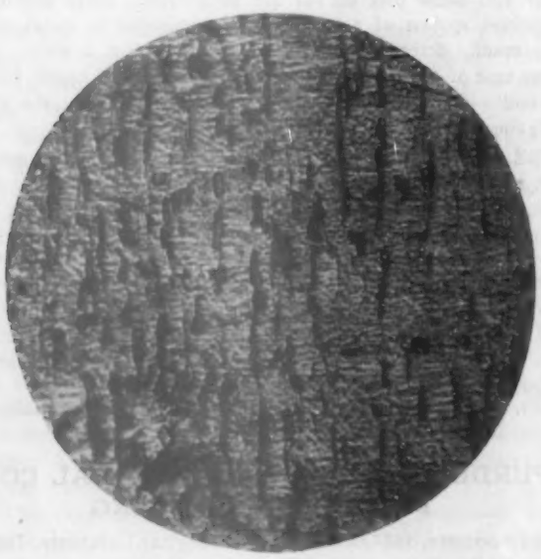


Fig. 7.

Slag or other solid nonmetallic impurities called Sonims are shown here as elongated grey streaks imbedded in the metal. Magnification 180 diameters.

equilibrium. Now in molten cast iron all the carbon exists as a solution in the iron and so this is its equilibrium or normal condition. At room temperatures, much of the carbon in cast iron neither dissolves nor combines with the iron normally but is scattered throughout the mass as fine flakes of graphite. If molten cast iron is cooled slowly, there will be time for the condition of the carbon to change so that at each successively lower temperature it will be in the normal or equilibrium condition for that temperature. Gray cast iron will result. On the other hand, if molten cast iron is chilled more rapidly than the carbon can change its condition, the condition representing equilibrium at molten temperatures will be literally brought down to room temperatures and white iron will result. Metallographists have carefully determined equilibrium conditions not only for alloys of carbon and iron at various temperatures but for most of the useful alloys. They find that usually for any given alloy, certain equilibrium conditions persist over a definite range of temperature but that the moment this range is crossed to either higher or lower temperatures, new equilibrium conditions appear. The limiting temperatures of such a range are called the critical temperatures and the range itself, the critical range. From what has been said, it will be seen that a map can be drawn which will show the equilibrium condition

at all temperatures for all relative proportions of two elements alloyed together. Such a map is shown in Fig. 6 for iron-carbon alloys. This is usually called an equilibrium diagram.

It should now begin to be clear that the metallographist can tell the welder many things which the chemist can not. The chemist can tell what elements are present in a metal and how much there is of each but the metallographist goes farther and tells what condition these elements are in. How extremely important this is will be appreciated by realizing the enormous difference in the properties of chilled white iron and gray cast iron each of the same analysis.

Many terms have been devised to denote the various conditions of carbon in iron. Among them are Sorbite, Troostite, Martinsite, Pearlite, etc. When a steel is composed entirely of pearlite, which is true of a normal steel containing about .85 carbon, it is said to be of eutectoid composition. There are hyper-eutectiod steel containing more carbon and hypoeutectoid steels containing less. When one element or metal dissolves in another metal as salt does in water and does not separate out even when solidified and cooled down to room temperatures, a solid solution is said to exist. Elements or metals that form solutions are said to me miscible in each other and those that do not are immiscible. Solid non-metallic impurities spoken of as sonims are immiscible in metal and are very readily detected with the microscope. Fig. 7 shows an extreme case of the presence of sonims in a piece of barely defective welding rod which would be passed as perfect by the chemist analyzing for the customary impurities.

This article makes no attempt at being a treatise on metallography. It is intended to point out in an elementary way how a photomicrograph is taken, what it represents, and to explain briefly the meaning of a few of the commoner technical terms often employed by those who use such pictures to illustrate what they write concerning welding and related subjects. Those who practice or employ fusion welding processes in the future will find themselves dropping behind in the competitive race if they have not at least a smattering knowledge of the art and language of the metallographist.

PURDUE PLANS SECOND ANNUAL CONFERENCE ON WELDING

In December, 1925, Purdue University, at Lafayette, Indiana, through its Engineering Extension Department, offered a two-day educational conference on welding. The conference was opened to executives and others interested in welding problems of industrial plants throughout the state, and scores of industries were represented by their superintendents, foremen, plant managers and operators who attended. It was attended by 175 men from ninety-three industries in thirty-seven different cities. The program consisted of lectures, moving pictures and actual demonstrations to show the principles of the different welding process and the great variety of their applications in industry. Many of the engineering students at the school took advantage of all their open time during the two days of the program to attend the lectures and demonstrations, so the lecture room was always filled with a crowd of interested listeners.

The interest shown in last year's conference and the request coming to Purdue University for the establishment of a conference on welding as an annual affair has influenced the Engineering Extension Department to announce a similar conference to be held in Lafayette, Indiana, this winter. The date set for the Second Annual Conference on Welding is December 15th, 16th and 17th. The Conference will open during the forenoon of December 15th and will close on Friday noon, December 17th. Those interested in this Conference should notify the Engineering Extension Department of Purdue University and they will be placed on the mailing list to receive advance notices and other information concerning the program for this meeting.

It is intended to make this year's program provide information of a fundamental nature, regarding all of the welding processes and their applications. A general invitation is extended to industrial plants to send representatives who are in charge of welding operations or who should be informed on the subject of welding and every effort is being made to arrange a series of talks and demonstrations which would be of the greatest possible value to the industrial public. If it can be expected that the work will resemble last year's program it is not often that such a complete coverage of the subject of fusion welding is offered in such a convenient form.

BRONZE WELDING AGAIN PROVES ITS WORTH

Results in Securing One Hundred Per Cent Alignment in Repairing Broken Pinion Bearing.

In repairing the tail stock of a lathe, weighing 3,800 pounds, by welding a break through the pinion bearing, the problem was to secure one hundred per cent alignment in the bearing upon completion of the weld. By the use of bronze welding, which obviated necessity of extensive preheating and consequent possible distortion, the Weldrite Company, master welders, of Long Island City, N. Y., successfully solved this problem.

Welding Broken Pinon Bearing.

The casting was prepared for the welding operation by chipping broken sections, which required eight hours work, and then slightly preheating by use of charcoal flame.

For repairing break through pinion bearing Oxweld bronze rod number ten was used. For building up wearing surfaces of guides, and also the front of pinion bearing where wearing surface was required, Oxweld manganese bronze rod number eleven was employed. Flux was used. The time required for actual welding was eleven hours' labor by two welders.

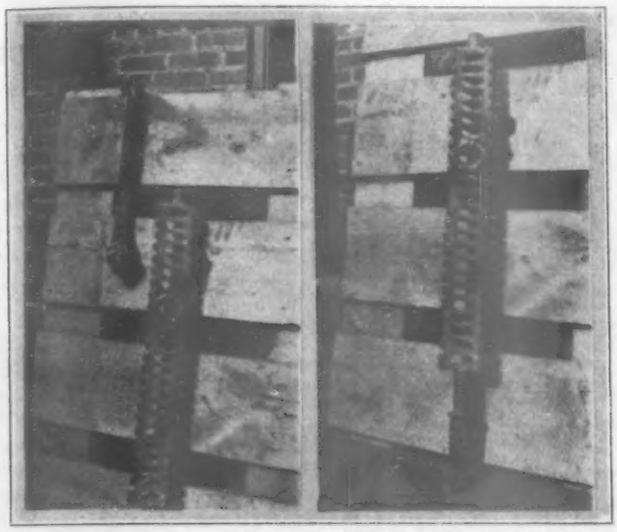
Upon being placed into service the welded tail stock provided perfect satisfaction owing to the one hundred per cent perfect alignment of pinion bearing. Again the value of bronze welding on cast iron was amply proved.

NEW HOLLUP SUPPLY CATALOG

The C. H. Hollup Corporation, of Chicago, manufacturers of Hollup electrodes, welding rods and welding accessories recently issued Catalog No. 120, devoted to welding supplies. This is a twenty-four page pocket size book. It illustrates and describes the Hollup line of electrode holders, welding cable, face shields, helmets, lenses, gloves, wire brushes, goggles, sand blast equipment and fluxes.

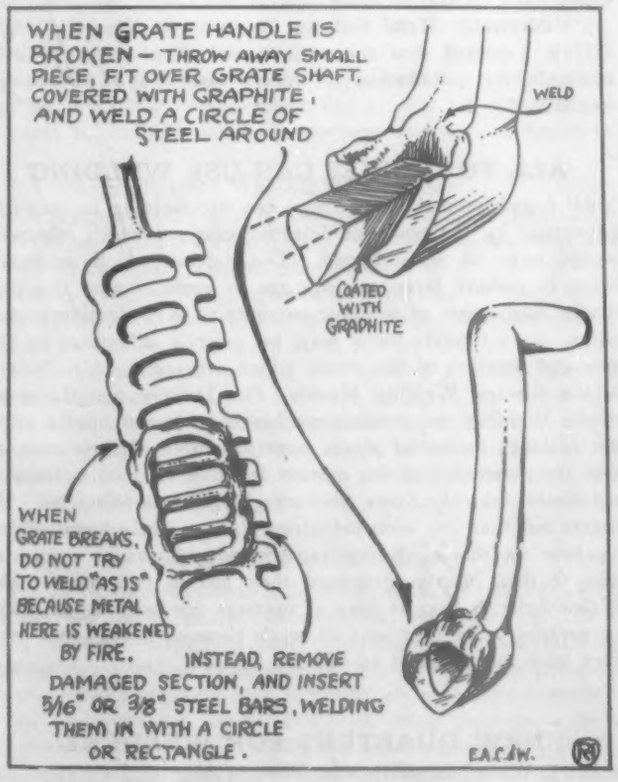
GETTING READY FOR COLD WEATHER WELDING

With cold weather coming on the season for repairing boiler sections, grates and grate shaker handles is here. The



Repaired Grate Bar and Shaker Handle

photographs shown here were sent in by Mr. C. J. Holslag of the Electric Arc Cutting and Welding Company, Newark, N. J., as a reminder of the fact that this kind of work comes up in the welding shops at this time. The sketch is self-explanatory and gives the principle instructions for doing this


WHEN GRATE HANDLE IS BROKEN – THROW AWAY SMALL PIECE, FIT OVER GRATE SHAFT, COVERED WITH GRAPHITE, AND WELD A CIRCLE OF STEEL AROUND
WELD
COATED WITH GRAPHITE
WHEN GRATE BREAKS, DO NOT TRY TO WELD "AS IS" BECAUSE METAL HERE IS WEAKENED BY FIRE.
INSTEAD, REMOVE DAMAGED SECTION, AND INSERT 5/16" OR 3/8" STEEL BARS, WELDING THEM IN WITH A CIRCLE OR RECTANGLE.
E.A.C.&W.

How to Make These Repairs

kind of work with the electric arc. Mr. Holslag's Arc Welding Handbook devotes considerable space to making cast iron repairs with the arc, and welders who want to brush up their knowledge of the subject would do well to consult this excellent text.

A PIONEER IN PIPE WELDING

By D. J. Matelski

Much has been said and done in regard to pipe welding. But I would like to give credit to a pioneer, who has done much to further this branch of the welding industry. The late Carl Schirmer, of the Schirmer Bros. Plumbing and Heating Co., of Hibbing, Minn., by his arduous work brought about a piece of welding engineering, that will stand for many years to come, as a monument to his confidence in welding. Mr. Schirmer, was a master plumber and steam fitter, who by his zeal won over an entire municipality in favor of the welded joint in preference to the screwed joint.

An Ideal Opportunity

Back in 1919 plans were laid to move the entire business district of Hibbing a mile south, due to the encroachment of the iron mines then opening up new territory. Mr. Schirmer was foresighted, and proposed the welding of an entire municipal heating system. Mr. Schirmer along with Mr. Foster, then superintendent of the Water and Light Dept., also an engineer of note, succeeded in having the village fathers enact an ordinance to the effect that all steam, heating and gas mains were to be welded, wherever covered under ground, except in manholes or other places designated. This also included service lines from the mains; this alone was a great step as it compelled all plumbers to weld the service lines between mains and house.

Schirmer Bros. were awarded the contracts to lay and install all pipes, valves and fittings. They began work in the fall of 1919, laying the steam line, a 14 in. main with 6 in. return, to run from the power house 3 blocks south then reduce to a 12 in. main with 6 in. return to extend 6 blocks west, and 1½ blocks east. The other lines south from this main are 8 in. and 6 in. with 4 in. and 2 in. returns, as near as I can recall the figures. The system is a low pressure vacuum system. There is never much over 11 pounds per sq. in. on the mains. The steam passes through the house and on condensing passes through a meter, thus registering the amount of steam used. The water then passes through the return by gravity and vacuum back to the boilers at the power house.

This system is economical both to consumer and the municipality. The steam mains are laid in Rickwell tile, resting on a concrete base. The Rickwell tile has a mineral wool filler used besides the asbestos filler molded inside the Rickwell, to facilitate any movement of expansion or contraction.

Other Contracts Followed

During 1919-20-21-22 the same firm was awarded contracts to lay and install something like 45 blocks of steam main, besides over 100 blocks of gas mains from 4 in. to 2 in. diameter. All joints are welded except where screwed into valves or expansion joints in manholes. At first Mr. Schirmer sublet the welding contracts, in 1919 to a Duluth welding firm, in 1920 obtaining a welder of his own. Later, in 1920, he discontinued doing his own welding, subletting the welding to my shop, I did the welding until the summer of 1922 on a straight hour basis, sometimes employing 3 welders besides myself. This enabled me to take care of the other plumbers who were installing services to homes.

As to welding, the pipe was ordered threaded, as very little time was lost in cutting off the threads the welder cutting his bevel while doing so, as fast as a man could turn the pipe. Where the ground permitted we welded on the surface, welding about 200 feet or the length required between manholes, before lowering into the ditch. But all 12 in. or larger pipe was welded in the ditch on V rollers. The gas mains, wherever the ground permitted, were welded into lengths about 2 blocks long then dropped into the ditch and tested. I found by using two welders on the same weld on all pipe over 8 in. we overcame the tendency of the weld to cool too fast on

the finished side, drawing the pipe out of line. One man started halfway down the side, the other halfway down the other side, working towards the top, using the ripple weld. When the top was reached the pipe was turned half over, using the same procedure to complete the weld. Welding time for 2 men on 12 in. pipe, ⅜ in. thick, was about 35 minutes. On 6 in. and 8 in. pipe only one welder was required. The usual welding time for a 6 in. pipe weld was from 10 to 18 minutes, depending on conditions.

Testing the Joints

After a section had been welded and lowered into the ditch it was tested with cold water using city pressure, which was about 100 pounds. Very seldom did we ever have a leak. This heating system has been in constant use since 1920 without giving any trouble except that in one instance the 12 in. main broke 3 flanges, where bolted to the anchored valve in the manhole. This was caused by a cave-in that allowed the concrete to settle and break between the manholes, also breaking the Rickwell, letting the earth settle around the pipe so the expansion and contraction could not be taken care of by the expansion joint on the other end. Later this section was dug up and repaired, and has caused no trouble since.

It was a mean job to repair this broken flange, due to the manhole being so hot from the steam leaking into it. Sometimes we waited for days for the weather to moderate so we could shut off the steam on this line without inconvenience to the consumers. As to the repair, I cut the pipe off about 20 in. from the flange, took the end out, screwed on a new flange, bolted in place and welded, having to stand on my head while welding the bottom for lack of room, also getting a fine sweat bath, along with a few inches of quite hot water to lie in. It broke during the cold weather, calling me back 90 miles from where I was hunting ducks.

High Pressure Lines

Mr. Schirmer has also installed quite a bit of high pressure line which I welded for him in 1920-1921, one line to a bakery using 6 in. main and 2 in. return, another between the school power-house and the new high school, which I may also state is reputed to be the largest school in the U. S. under one roof. This latter line is 400 ft. long of 12 in. pipe with 6 in. return all welded; with 3 special welded ells to get around some difficult corners, and still give the utmost capacity for steam. Even the anchors of 8 in. channel iron are welded to the pipe, upright, each end embeded in the concrete manhole. One man and myself using a 50 lb. generator completed the welding in 8 days. In this high school is also incorporated a novel idea of Mr. Schirmer which again shows his foresight. Instead of using reducing tees for the lines going up from the basement for radiators, he asked me to cut holes in the pipe wherever needed, and weld in nippples of the size required, thereby eliminating the expense of large reducing tees from 8 in. down to 1½ in. and 2 in., also saving many dollars by not having to cut and rethread pipe. I welded in something like 1000 nipples in sizes from 4 in. to 1½ in. Mr. Schirmer also installed some twenty-four 12 in. by 24 in. high pressure sediment traps all welded even to connections, which have given good service.

A Real Pioneer

Not only has Mr. Schirmer been the means of giving the village of Hibbing a heating and gas system that ranks second to none, but he was a stanch defender and booster of welding. Mr. Schirmer met an untimely end in an auto accident over a year ago. Not only have the plumbers and steam fitters lost a man from their ranks who showed great judgment and foresight by combining the facilities of welding with steamfitting, but the welding industry has lost an arduous booster and well wisher, who has done a great work and done it well. His work has done much to further this branch of the welding industry through this state.

May we see more plumbers and steam fitters follow in his footsteps and adopt welding to their respective lines.

I. A. A. CONVENTION PROVIDES SPLENDID LIST OF PAPERS

This issue of *The Welding Engineer* is going to press just as the International Acetylene Association is holding its twenty-seventh convention at the Congress Hotel, Chicago. The program extends over a three-day period, of which about two days are devoted to the reading and discussion of a series of technical papers which will stand as a remarkably fine contribution to the literature of the industry. Following is a list of the papers announced in the final program:

Use of Welding on Naval Vessels.....Commander H. H. Rossell, Construction Corps. U. S. Navy

Selection of a Welding Process.....L. E. Everett, Nugent Steel Castings Co., Chicago, Ill.

A Few Factors to Be Considered for Accelerated Progress of the Gas Welding Industry.....Dr. A. Krebs, General Welding and Equipment Co., Boston, Mass.

The Most Important Thing in Welding.....S. W. Miller

Does Oxy-Acetylene Welding Suffer from Defective Welding by Other Processes.....G. O. Carter

Production Welding on Steel Furniture.....M. F. Bayer, Simmons Co., Kenosha, Wis.

Some Applications of Bronze Welding.....W. C. Swift, American Brass Co., Waterbury, Conn.

Heat Treatment by the Oxy-Acetylene Flame.....E. E. Thum

How the Moving Picture Is Educating the Public and the User.....Geo. E. Harcke, Air Reduction Sales Co.

Underwater Metal Cutting.....L. F. Hagglund, Underwater Metal Cutting Corporation, New York City

It is expected that the majority of these papers will be available for publication in future issues of *The Welding Engineer*.

ALL FOUNDRIES CAN USE WELDING

All foundries making castings can use welding to excellent advantage for the repair of defective castings which otherwise would have to be scrapped. The defects which ordinarily occur in making large castings are so common that this particular application of welding amounts to a production proposition, even though there may be quite a difference in the size and location of the welds which are made. Mr. Wilkie, of the Electric Welding Machine Co., Detroit, manufacturers of the Weldrite arc welding machines, points out that a number of large industrial plants have foundries of their own, so that the total size of the market for this kind of welding is not covered by the firms who are classified as foundries. He points out that one such industrial plant recently installed one machine for this kind of salvage work and was so successful with it that shortly afterward they put in two more. Mr. Wilkie believes that as long as castings are used welding will be necessary for that sort of work because it does not take very long for an outfit to pay for itself.

NEW QUARTERS FOR WELDENE

W. J. White, formerly with Burdett Mfg. Co., Chicago, has purchased the assets of the Weldene Corporation, and has opened up a new office for the company at 608 S. Dearborn St., Chicago. The products of the firm include cast iron solder, aluminum solder, and soldering fluxes. These solders have a wide range of usefulness in welding shops and industrial plants for making repairs which are more readily soldered than welded.

Welding Show at Buffalo

Technical Sessions Provide Valuable Papers on Several Subjects of Current Interest to the Welding Industry

ON November 16th the American Welding Society opens its annual fall meeting in the Broadway Auditorium, Buffalo, New York. The first afternoon will afford an opportunity to visit the exhibits which have been prepared in connection with the meeting, as no technical sessions will be held on that date.

Locomotive Welding

On Wednesday morning Mr. M. Gjersten, master mechanic of the Northern Pacific Railway Company, presents a paper on the welding of locomotive parts by the oxy-acetylene, electric and thermit processes. The paper is confined to the major welding operations, and such others as are most common in locomotive work. It is pointed out that thermit welding is almost entirely limited to the welding of engine frames. The general run of castings and parts made of cast iron, brass, bronze and other nonferrous metals are welded with the oxy-acetylene process, although some very heavy cast iron sections are thermit welded. When preheating is undesirable, electric welding is used for some cast iron repair work. Where there is a choice of processes the attempt is made to pick the one which will do the work most economically and to the best advantage. A list of repair jobs in locomotive and car work is given with the usual selection of welding process for this work indicated. In calculating the economies effected by welding it is necessary to keep extensive records for a long period of time in order to strike a fair average. As an example of the savings effected, six locomotive drive wheel centers were repaired at a total saving of $1,200.00, six locomotive cylinders at a total saving of $4,000.00, six engine tender bolsters were repaired at a saving of nearly $450.00. As far as workmanship is concerned, it is noted that a competent welding instructor or supervisor can readily tell whether the operator is qualified or not to perform the work assigned to him.

Railroad Welding Organization

Another paper on the Wednesday program is "Organization of Welding on the Railroad," by F. H. Williams, assistant test engineer, Canadian National Railways. This writer calls attention to the work of the welding committee of the Association of Railway Electrical Engineers, who have compiled a manual on electric welding, in loose leaf form. The discussion of the organization of welding and general practice followed on the Canadian National Railways is taken up under the topics of training of operators, inspection and testing of work, selection of material for welding, design of parts to be welded, organization of supervisory force, standard instructions for welding, control of welding method and procedure, check on service results and economics.

Structural Steel Welding

The afternoon sessions on Wednesday, November 17th, are devoted to the subject of structural steel welding. In a paper entitled "Structural Steel Joints and Fundamental Design for Arc Welding Connections," Mr. A. M. Candy presents the results of tests on welded joints which have been described in the two previous issues of *The Welding Engineer*. In a paper entitled "Tests on Welded Roof Trusses," Mr. H. H. Moss discusses the tests of oxy-acetylene welded trusses, which were discussed in the August issue of *The Welding Engineer*. The subject of structural steel welding is a very live one in the welding industry at this time and these two papers present some new useful ideas on the design of joints to be welded. A committee has been formed to study this particular application of welding, and represented on the committee are engineers from some of the largest structural steel fabricators in America. There is no doubt as to the future of the process in this field and the discussions of this subject at the Wednesday afternoon meeting should certainly be worth the attendance of any one who is interested in this type of welding.

Welding in Universities

The Thursday morning session will be devoted to a discussion of welding science in the engineering curriculum of universities. Papers have been secured on this subject from a number of university professors and further discussions are invited. Profesor S. T. Hart of the Mechanical Engineering Department, Syracuse University, made a survey of one hundred of the leading engineering schools to get a line on what place welding had in the instruction program. Thirty per cent of those who replied are already using electric apparatus, 60% are using gas apparatus and 10% are using thermit apparatus; 47% have students use the apparatus, 50% give lectures on welding and 81% explain welding to the students. Other information secured in this survey indicates that the universities as a whole regret that they are not able to give more time to the subject and that there is a tendency to give an increased amount of attention to it. Visits to universities are suggested and attention is called to the fact that lectures on welding would be welcomed by most of them. Professor O. D. Rickly, Ohio State University, points out that the welding processes are in such a rapid state of development that it does not seem wise to attempt very much instruction along lines which promise to become obsolete in a short time. As soon as sufficient data has been obtained and method and materials sufficiently standardized welding will deserve more consideration in engineering fields. Professor W. P. Turner, Purdue University, reviews the field covered by different processes and states that welding is demanding the attention of engineers in both industrial and educational work. It is not deemed advisable to make operators of engineering students, but it is thought that enough time should be given to instruct the students regarding the usefulness of welding and to help to know when he can call on welding to solve some of his problems. He recommends lectures, demonstrations and practice, and also a well equipped laboratory with complete welding stations and all accessories. Professor Ernest L. Lucas, of the Mississippi Agricultural and Mechanical College describes the operation of an elective course in modern methods of welding metals. The complete course is of sixteen weeks duration, one shop period of three hours being given each week, or a total of forty-eight hours shop time for the course.

Thursday afternoon will be devoted to meetings of the welding wire specifications committee of the American Bureau of Welding and a Dinner Dance is scheduled for that evening.

Welding in Gaseous Atmospheres

Friday morning a short technical session on the subject of welding in a gaseous atmosphere will include demonstrations and exhibitions by Mr. P. P. Alexander and Mr. R. A. Weinman. This interesting welding process was described in the March issue of *The Welding Engineer*. The possibilities of improving the arc welding process by surrounding the arc with a gaseous atmosphere have been discussed freely during the past few months and this session will afford an excellent opportunity to see the process in actual operation.

There will be a meeting of the board of directors late in

the forenoon, Friday, and in the afternoon an inspection trip to Niagara Falls and through the Niagara Power House is planned.

Exhibits

The exhibits of welding equipment and welded products will be open Tuesday afternoon, November 16th, and will remain open until 5 P. M., November 19th. The following firms will be represented by exhibits of welding equipment and supplies and also of samples of welded products:

King Refractories Co., 1707 Niagara St., Buffalo, N. Y.
Beals, McCarthy & Rogers, 40 Terrace, Buffalo, N. Y.
Bearium Bearings, Ellicott Sq. Bldg., Buffalo, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.
Niagara Falls Power Co., Niagara Falls, N. Y.
Sherwood Mfg. Co., 1710 Elmwood Ave., Buffalo, N. Y.
Air Reduction Sales Co., 730 Grant St., Buffalo, N. Y.
Federal Machine & Welder Co., Warren, Ohio.
Endress Mfg. Co., Cortland, N. Y.
U. S. Light & Heat Corp., Niagara Falls, N. Y.
Gibb Welding Machines Co., Bay City, Michigan.
Alloy Welding Processes, Ltd., London, England.
Transportation Engr. Co., 269 37th St., Brooklyn, N. Y.
Allan Mfg. & Welding Co., 726 Wash'ton St., Buffalo, N. Y.
Northwestern Mfg. Co., Milwaukee, Wis.
Metal & Thermit Corp., 120 Broadway, New York City.
Carbic Mfg. Co., Duluth, Minn.
Una Welding & Bonding Co., Cleveland, Ohio.
Thomson Electric Welding Co., Lynn, Mass.
Shawinigan Products Co., 110 Williams St., New York City.
Page Steel & Wire Co., Bridgeport, Conn.
Alexander Milburn Co., Baltimore, Md.
Purox Company, 2101 Blake St., Denver, Colo.
American Brass Co., Waterbury, Conn.
Burke Electric Co., Erie Penna.
Swift Electric Welder Co., Mt. Elliott Ave., Detroit, Mich.
Liquid Air, Ltd., London, Eng.
Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J.
General Electric Co., Schenectady, N. Y.
Acheson Graphite Co., Niagara Falls, N. Y.
Wickwire Spencer Steel Co., 41 E. 42nd St., New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Buffalo Gasolene Motor Co., 1080 Niagara St., Buffalo, N. Y.
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
Torchweld Equipment Co., Fulton St., Chicago.

Among the exhibits will also be included the publications serving the welding industry: *The Welding Engineer* and The Acetylene Journal, of Chicago, Illinois.

WELDED STEEL PIPE LINE FOR MARIN MUNICIPAL WATER DISTRICT

A recent issue of "Western Pipe and Steel News," published by the Western Pipe and Steel Company of California, described the construction of a welded steel pipe line to serve the water district comprising practically the whole of southern Marin County. The pipe line consists of thirty thousand feet of twenty-six inch pipe and seventy-four hundred feet of thirty inch pipe. All of the pipe is built of quarter inch steel plate by the Western Pipe and Steel Company. The construction involves some interesting mechanical and engineering problems. For example, the narrowness of the road made it impossible to store the pipe, so practically every section was unloaded at its final place. The line curves its way through a beautifully wooded and hilly country, making necessary the use of a great many angle connections. In many parts of the line almost every section of the pipe had to be cut at an angle.

The pipe is made and shipped in fourteen foot sections, rolled from a single plate. All longitudinal seams are electric welded with full automatic, General Electric arc welder. All end seams were acetylene welded. The welds made by shop welders were subjected to a continual program of strength tests, sections being selected from the pipe at random for testing purposes. Out of thirty test pieces pulled only one broke in the weld and that one had developed a weld strength of ninety-four percent. Electric welded joints were bent across the weld through an angle of approximately 180° without breaking. Correspondingly good results were shown when tests were made of the acetylene butt welds. Further the tests were run to determine the quality of different welding rods.

USE WELDING TO MAKE JIGS

An article recently published by one of the mechanical papers points out the value of welding in the construction of jigs and fixtures for production work. Most fixtures of this kind can be made by welding together pieces of stock shapes of structural steel. It is both quicker and cheaper to cut pieces from standard steel shapes and weld them together than it is to make a pattern and then machine the piece out of a casting. Where hard wearing surfaces are desired, they can easily be obtained by welding a hard material on the soft steel stock wherever it is needed. The welded piece will average to cost about one-third the cost of a pattern for making a casting, and on account of the greater strength of the steel, the weight, of such jigs and fixtures can be considerably reduced. An important feature of welded fixtures is that they can be produced quickly, almost on a moment's notice.

BISSELL TALKS TO ELECTRIC CLUB OF CHICAGO

On Friday evening, October 29th, Mr. A. G. Bissell, Engineering Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, read a paper on the subject of The Arc Welding of Structural Steel before the Electric Club of Chicago. The paper, which was illustrated by a number of lantern slides, discussed the fundamental principles of arc welding, then gave a number of illustrations of successful welding jobs on heavy structures. This was followed by a description of tests which have been made to show how welded joints will stand vibration.

NEW TORCHWELD CATALOG

The Torchweld Equipment Company, Chicago, Illinois, manufacturers of the Torchweld line of oxy-acetylene welding and cutting equipment have just issued a new thirty-two page catalog for the trade. The new catalog is pocket size, 4x9 inches, with the same cover design in three colors which has been used on the previous catalog of a larger size. The book gives diagrams and complete information concerning the design and construction of the different items of Torchweld Equipment. The complete line includes cutting torches, welding torches, regulators for all cutting and welding gases, complete welding and cutting outfits, replacement parts, welding rods, and accessories.

RACO PROCESSED ELECTRODE AN INSTANT SUCCESS

Reid-Avery Co., Inc., producers of Raco Welding Rods, report that their new Raco Processed Electrode, produced in their new plant at Baltimore, Md., has met with the immediate approval of many welders throughout the country and that while this new electrode has been on the market for only a month, they are turning it out to the extent of 100% of their production means.

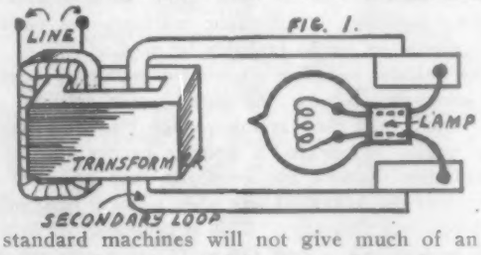
The Raco Processed Electrode is of .13-.18 carbon, .40-.60 manganese with all impurities under .04. It has been developed primarily for direct current welding where bare wire has not given satisfaction, but also secures good results on alternating current. Particular stress is laid on the uniformity and reasonable price of the new rod.

Principles of Resistance Welding

Nothing Mysterious About Queer Looking Machines Which Make Welds in a Fraction of a Second—"Heat and Squeeze" Is the Explanation

ELECTRIC resistance spot and butt welding are processes widely used in the fabrication of an almost endless array of metal products. The actual operation of the machinery is apparently so extremely simple that to the unimitated it would seem unnecessary for the subject of skill to be considered. It is true, however, that this type of machinery needs to be treated with consideration and operated in a common sense way, just as any other piece of production machinery. In fact, there are factories using this type of equipment who have a real systematic plan of training men who are to make resistance welds.

It should be easier to operate resistance welding equipment and also to select such equipment if something is known about the nature of the operation. An exterior examination of any



of the standard machines will not give much of an idea of what goes on when the weld is made. Two pieces of metal are brought together, there is a sudden flash, and before we know it the weld has been completed. There is something mysterious about the work until the principle of resistance welding is explained in simple terms.

During the past year or so the American Electric Fusion Corporation of Chicago, Illinois, manufacturers of spot and seam welding equipment, have prepared a series of bulletins in which a part of the space is devoted to an explanation of the principle of electric resistance welding. The information contained in this series of bulletins should be of considerable value to those operating this type of equipment or contemplating the purchase of it. Through the courtesy of the above mentioned company this material has been secured for publication here.

Principle of Electric Spot, Butt and Seam Welding

Stripped of all technicalities and forgetting such accessories as transformers, electrodes, etc., the electric welding of the so-called resistance process type, commonly known as butt welding, spot welding and seam welding, can be defined by three words, "heat and squeeze" process.

In principle it involves the same actions as were used by the blacksmith in ages gone by. The blacksmith applied heat to the pieces, about to be welded, externally by placing these in a forge, and when they reached a plastic state or so-called "white heat," he united them by a pressure, resulting from hammer blows.

Electric welding goes through practically the same cycle of operations, excepting that the passage of electric current through the work generates the heat within the work, and when the pieces reach the plastic state a steady pressure supplied by any of the well known mechanical means, are provided to produce a squeeze.

The electrical principle involved is extremely simple. The incandescent lamp produces light because its filament is heated to an intense white heat by the passage of the electric current through it. It is the opposition, or resistance, of the filament to the passage of electric current, which causes transformation of electric energy into heat energy.

In the incandescent lamp the current is carried by copper wires up to the filament, the filament itself being made of material of resistance much higher than copper.. Thus, no perceptible heat is generated in any other portion of electric circuit except in the filament.

In electric welding, the work to be welded corresponds to the filament of the lamp. The electric current is carried up to the point of the work by heavy copper conductors, thereby concentrating all the resistance of opposition to the passage of electric current in the work. That opposition causes the work to heat, so that it reaches "white heat" or becomes plastic.

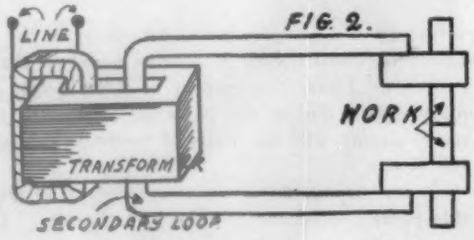
When the proper heat or plasticity is reached, the electric current is cut off and the pressure applied, which causes plastic particles of one part to intermingle with the plastic particles of the other part, thereby resulting in a weld.

Figures 1 and 2 show graphically, the similarity of circuits of the incandescent lamp and of the electric welding machine. By examining the above two circuits it will be seen that the circuit in each case consists of the source of current and the filament in one instance, and the work in another instance connected into one continuous loop or circuit. Considering the purpose of such circuit the maximum resistance in both cases must be concentrated in the part that is to be heated.

In accordance with the laws governing electric circuits, the rate, in watts, at which heat is evolved at any portion of the circuit is proportionate to the current, in amperes, multiplied by itself and multiplied by resistance in ohms, or in the form of a formula:

$$C \times C \times R = W.$$

Where C = current in amperes, R = resistance in ohms, W = rate in which watts at which energy is converted into heat. Examining formula given above in connection with



Figs. 1 and 2, the circuit being a continuous loop, the same current must flow through any portion of it. The value of such current depending upon the electric pressure or volts, established by the source of current, be such source a generator, a transformer or storage battery. Thus, the heating effect will be highest where R = resistance is highest.

Electrical Features of Welding Machines

Referring to Fig. 2, it will be seen that the welding circuit, or so-called secondary loop, is usually very short—consequently, it requires a very small electrical pressure, or volts, to establish the current through it.

Welding circuits range in size from a total length of 50 feet, the latter length being the extreme, used in so-called welding jigs. To establish satisfactory welding current through such circuits, pressures from 2 to 16 volts are required. Experience has established that satisfactory welding can be performed where current strength per square inch of weld ranges from 12,000 to 17,000 amps.

The resistance welding process, such as spot-welding, could be carried out with either Direct or Alternating currents. However, in order to use Direct Current, special low voltage generators, similar to those used in plating work, would be required. The use of such generators is accompanied with numerous difficulties in maintenance an account of upkeep of brushes and commutators. Further, in order to switch the current "on" and "off," some form of a switching device would be necessary. Such switching device, designed for interrupting current of thousands of amperes, would be very cumbersome and expensive. For the above reason Direct Current has given place to Alternating Current where low voltage and high amperage capacity can be obtained by means of a transformer.

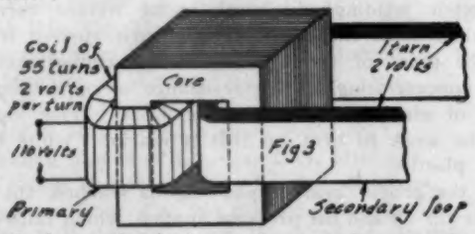


Figure 3 shows simple form of a transformer. Any transformer consists of three fundamental parts—the core, the primary coil and the secondary coil. The primary coil of welding transformer has many turns of comparatively small wire, while the secondary coil usually has one turn made of either flexible cable or flexible copper laminations of large cross-section, as one square inch of cross-section of copper conductor can only carry a current of about 1,000 amps. without undue heating. The principle of operation of a transformer is: If a voltage is impressed upon the primary coil, there will be impressed upon each turn of such primary coil a fraction of the total voltage. Thus, if 110 volts be impressed upon a coil consisting of 55 turns, there will be a potential of 2 volts upon each individual turn of the coil. If another coil, called Secondary, is linked with the same core, it will be found that the induction effect of the magnetism in the core established by the current in the primary coil, will induce in such secondary coil the same voltage on each turn as exists on the primary coil. Thus, if the secondary coil has one turn, a potential of two volts will be established in it.

Another feature of a transformer is its energy in the primary circuit, neglecting small losses, is always equal to that of the secondary circuit. Thus, if a current of 2,200 amps. exists in the secondary circuit due to the potential of 2 volts, the total in that watts circuit will be Volts $\times$ Amps. = Watts = 2,200 $\times$ 2 = 4,400 Watts.

In the primary circuit, however, a current of 40 amps. will produce this energy since the voltage is 110 Volts. Thus, by formula given above, 110 $\times$ 40 = 4,400 Watts.

This feature of transformer permits all the control of current to take place on the primary side of the transformer, by means of inexpensive switching devices.

BRADY LECTURES ON ELECTRIC WELDING IN KANSAS CITY

On Monday evening, October 25th, Mr. W. M. B. Brady, Arc Welding Specialist in the Chicago district for the General Electric Company, read a paper on Electric Welding before the Kansas City Section of the American Institute of Electrical Engineers at the Kansas City Athletic Club. Mr. Brady discussed both arc welding and resistance welding and mentioned the important applications under each classification, pointing out at the same time that electric welding is growing in importance and will soon be in a position to command a great deal more attention in the industrial world. This was the first meeting of the Kansas City Section of the A. I. E. E. and Mr. Brady's paper was very well received.

THE ARC-WELDING LOAD

By W. L. Warner

Industrial Engineering Department, General Electric Company

In general, the conception of arc welding as a load is formed in terms of the current and voltage at the arc which is causing the welding to take place. These range from 100 to 800 amperes and from 20 to 40 volts, and are supplied to the arc from some direct-current source that is usually a special welding motor-generator set. The generator of this set may be of either the single-operator or multiple-operator type.

The over all energy efficiency of the single-operator machine is somewhat higher than that of the multiple-operator machine because of the series resistors used in the welding circuits of the latter for current and voltage regulation, and for this reason one might suppose that the purchaser of welding equipment would generally prefer single-operator sets; but such is not the case. The considerations of first cost, upkeep, and power-factor are often deciding features. Also the manner in which the welding is to be done has a distinct influence in the selection of the type of equipment to supply the welding energy. Where all the welding is done by hand and the operators are working at widely seperated locations, perhaps not in the same building, single-operator machines are chosen. On the other hand, where several welders are working together, or automatic machines are employed, a multiple-operator set would probably be used.

It is impracticable to utilize synchronous motors to drive single-operator generators because the horse power required is comparatively small and the variable-voltage characteristics of the generator would necessitate a separate exciter for the motor. Hence, induction motors are employed, and as a result, the power-factor of the individual sets when running light may be as low as 25 per cent (lagging). This is ordinarily of little consequence so long as only a few (10 to 15) such sets are installed and the power-factor of the remaining load on the feeder is acceptably high. However, in case there is a considerable number of other induction-motor drives connected to the same service feeder, or the number of single-operator sets is large or may become so (30 or 40 in some shops) the matter of power-factor is of real concern.

Under such conditions, the advantage of improved power-factor can be obtained by installing a comparatively few large induction-motor-driven or synchronous-motor-driven multiple-operator sets. These induction-motor sets when running light may have a power-factor of 25 to 30 per cent (lagging), while with synchronous-motor sets the running light power-factor will be about 80 or 85 per cent (leading). Another advantage of synchronous-motor drive is that the machine can be readily designed to operate at a still higher power-factor.

Obviously, the load-factor will tend to have a more beneficial effect on the power-factor of the welding load when multiple-operator sets are used than when a larger number of single-operator sets of equivalent total output are in operation.

Welding loads are inherently of a fluctuating character. At best, the load imposed by one welding arc is suddenly applied and as suddenly removed. However, the maximum variation is ordinarily so small compared to the total load on a feeder that its effect is negligible. In case a number of welders are at work either with single- or multiple-operator machine, the diversity-factor can be depended upon to spread the peaks into a comparatively uniform load.

The rapid development and increasing use of automatic welding machines has brought about a greater demand for large sets of the multiple-operator type which may be driven either by induction motors or synchronous motors.

While the welding load in general has been of minor amount compared to other industrial loads, it is fast growing in magnitude as shown by the following figures:

Estimated kilowatt-hours of welding and cutting load:

Year 1923..... 270 millions
Year 1925..... 350 millions

This load is equivalent to about 6 per cent of the electrified load of the iron and steel industry.*—*General Electric Review.*

Pointers on Heat Treating

Making Floor Scrapers Out of Discarded Leaf Springs Requires a Little Knowledge of Forging, Tempering and Grinding

By Will Stewart

BERT MORTON had just turned off his torch and was laying it down when a clattering racket caused him to whirl about. Standing at his left, a broad smile on his moon face, was Mr. Lawson, the boss.

"Just a little job for you," said he, chuckling at the startled movements of the welder. "You know I promised you a variety of welding and heating jobs, if you came to work for me."

"Humph," answered Bert, his eyes fixed on three pieces of bent steel that had startled him so, "you did, indeed and if I stay here I see that I am going to become a 'Jack of all Trades.' What have you now?" He picked them up and started to examine them.

"They are floor scrapers and have to be drawn out to two and a quarter inches below the bend, resharpened, hardened and tempered. The customer said that he had had a blacksmith make them for him from Ford springs and that they were far better than any that he had ever been able to buy in the hardware stores. He wants three new ones made, with 9-inch handles and to be 2½ inches below the bend. I told him that I had a man that could do it and that he could have them by tomorrow night, sure." So saying he waddled off, leaving Bert turning them over in his hands.

Equipped for the Business

Just a week ago Bert had stepped into the little enclosed space of the "Repairatorium." Rolfs Grayson of the Universal Torch & Oxygen Co. had given him a letter of introduction to Mr. Lawson.

Except for the door, the whole front was of plate glass. Passersby could see inside and not more than three feet from the window was a 6-inch swing lathe. To his left were the power saw, the power grinder and a medium sized, swinging table drill press. Across the floor, against the wall, was a long work bench. On it was clamped at intervals, several vises, a Duplex motor grinder, a sensitive drill stand. On the wall behind the bench, hung in order, were tools of every description.

The motor overhead hummed and the belts slapped as one of the three workmen started to take a cut with the lathe. Another made the room resound as he swaged down rivets and the third left his work at the bench to come to see what Bert wanted. Mr. Lawson was out, and while waiting Bert had a good chance to size things up.

There was just one note of discord. Signs were plastered on the window and hung about on the walls. "If it can be fixed, WE can fix it," "Do not throw away any broken metal article as Useless, unless you have first consulted us," "We employ only A1 mechanics, they can repair or make almost anything!"

Drawing to Length

Bert built up a loose brick furnace shaped so that the preheating torch would throw its heat just on the short bent section of the scraper. He placed one in the furnace and one beside where only the reflected heat would reach it, for the reason that if carbon steel gets red hot and soaks, as they say, it loses some of its hardening qualities.

Soon the scraper was bright red, so he withdrew it with the tongs and laying it on the anvil, hammered fast and hard. But he lightened the blows as the scraper cooled to dull red, and as it turned red-black he replaced it in the furnace. Carbon steel that is hammered when black-red has its grain fractured and will sometimes even show cracks when red hot, though usually not until it has cooled (contraction has set in) and sometimes not until it has been doused in the hardening fluid.

At last all three were drawn to the length. Bert now returned them all to the furnace and turned on the torch. He left it burning until they were all red hot, then he shut off the torch. This heating was to remove the forging strains.

New Scrapers From Old Springs

Bert stepped over to a bin by the side wall and withdrew a long, humped spring from it. Taking this over to the welding bench, he laid it down and after figuring a minute, marked off with a soapstone pencil three 12-inch pieces. Then he lit the cutting torch and started to cut.

Rebuilding his furnace he started the torch and now as each one grew red took it with the tongs to the anvil and straightened it out.

Then he started in to heat one for forging to shape, one he laid in the furnace, and one back where only the reflected heat would reach it, for carbon steel that is heated to red heat oxidizes and will not harden well. He took all the care that he could, to insure satisfactory scrapers. Mr. Lawson had impressed this on his mind: "We do only guaranteed work here. A workman is sure of his job only so long as his work is satisfactory. I can excuse an occasional mistake if the man is really trying, but if he isn't or he tries to lie to me, or seeks to misrepresent facts to me, he is through right then and there.

"Wirt Wilson has been with me for five years, Lon Carson three, Mort Austin, the lathe and machine man, has been with me only about four months, and while he is a good man, he makes his mistakes and he tries to lay them onto other causes than himself. I grant that he has made the excuses so plausible that every time I have seemed to see justice in his claims, yet just as soon as I can yet hold of another lathe man, he will have to take his excuses to another boss."

So, keeping the one that he was forging red hot, no matter how many times it had to be returned to the furnace, he slowly finished all three and then laid them away in the furnace to reheat.

While he was waiting for them to cool, he did a welding job that had come in. As soon as they were black, he dipped them in the water tub and then, picking up the first three, arranged them so that two only could get the heat of the torch, and set the others nearby where the reflected heat would get to them.

Heat Treating the Scrapers

Presently one showed blood red, and Bert watched closely, because in all carbon steels there is what is called the "refining" heat. If one douses them in the cooling medium just as they have reached this heat, the grain will be at its finest, the strength will be the greatest and it will do twice the work that a piece will that is heated a couple of hundred degrees hotter. Yet the change in color will be so slight that if one does not watch closely, he will wait too long and douse, now having a piece of steel of coarse grain, brittle and unable to stand the required strain.

He picked up the scraper and quickly sank it into the tank of oil (it was old cylinder oil) and swirled it round till the scraper ceased to sing, then let it sink down to be caught by the screen below. He was just in time to grab the second scraper and douse it in the oil.

"Close, old kid," he muttered. "You better take care for those bricks are now red hot and all the scrapers must be

pretty hot. You better put just one in at a time, 'cause if you make a miscabobble and get a scraper or two back on your hands and tell the Boss how you did it, he will think you are careless, and you need this job too much to be canned."

Clean Before Grinding

When all six now reposed in the bottom of the oil tank he grasped a couple of rings at each side and lifted out the catch basket. Taking out the scrapers he walked back to the water faucet and turning on the full force, washed all the adhering oil from the scrapers. He knew that in polishing them for tempering the oil would gum up the grits of the wheel and then when he heated them, the oxide on the surface would show false colors.

Taking them over to the bench, he picked up a file and tested each for hardness and was relieved when the file just skated over the edge. He replaced the carborundum wheel with one that was covered with a strip of fine carborundum grits.

He polished the forged section and up as for as the bend, leaving the lower scraping edge as it was, for if he had ground it down now, the heat when he drew it would likely run so fast that instead of straw, he would get brown, which would be 500 degrees instead of 450 degrees F., which he wanted.

Returning to the furnace he rebuilt it so that now the heat would hit against only the back end of the handle. Now at the bend came faint straw and he grasped the scraper with the tongs and slowly turned the scraper so that he could watch the color creep down the polished end.

Faster and faster the polished metal changed to straw and now the bend had changed to light purple. He stood ready, for the yellow was edging down and just as it reached the edge he quickly sank it in the tub of warmed water and moved it about till it cooled.

Tempering

Tempering is a ticklish task, for conductivity of the steel continually sends the heat from the point of higher heat to all the parts that are cooler. If he had held the scraper just a few moments too long before he quenched it, the color would have changed from yellow (450) to dark straw (470), to brown (500), to purple (350), to blue (550), to polish blue (580), and to pale blue (610), and to draw past this color would take practically all the hardness from the piece.

He stepped over to the motor grinding wheel and set about to give the scrapers their next to final sharpening. Unlike a great many persons who grind hardened steels, he was continually dipping the scraper in the cooling tank.

Grinding

All steels expand when heated and hardened carbon steels that are heated by contact from the grinding wheel, being hard and unable to give, will crack if they are dipped hot into cold water and this action repeated again and again. Fine hair lines form, so fine that they cannot be seen and only show up when the tool is put to work.

The hardener receiving the cracked and broken piece of hardened steel, looks at it and, remembering how much care he took with it while hardening, will say that it is a piece of faulty steel.

In grinding, too, before hardening, if the wheel glazes and burnishes the surface of the steel, when the piece is hardened these glazed spots will remain soft. Again, they will say that it is faulty steel all for the lack of a little real knowledge.

Welders who have tried to weld a score in a cylinder barrel will remember how impossible it was for them to get adhesion till they burned down below the skin and then only would the added metal stick as the rod was immersed in the molten puddle and melted off by rubbing against the bottom of the puddle. This is a parallel case, as the carbon content in the surface of the iron was burnished by friction till it took on a form that would not react the same as the rest of the surrounding metal.

Bert stepped over to the rear of the sidewall bench and took up a hone. With this he worked down the edge till it seemed razor sharp and when all were finished, he set one on top of another and wired them together, setting them away where nothing could hit against a finished edge and harm it.

FAST PRODUCTION OF AUTO BODIES

As an example of the progress which manufacturers resistance welding equipment are making in the development of new machinery to meet the demand for faster production of metal articles, the Federal Machine and Welder Company of Warren, Ohio, call attention to a new special butt seam welder which they recently constructed for assembling back panels in closed auto bodies. With this machine only five seconds are required for welding a fifty-inch seam on a closed car body. The actual length of welding along the curve of the seam is fifty-six inches. Of course it takes time to put the material into the machine and remove the welded section of the body, so this rate of welding is not maintained continuously. However, making allowances for the time it takes to handle the materials, the production is estimated at forty complete bodies per hour. The equipment for handling such work in reality consists of two machines mounted on a single base, each of them having an independent 200 KW transformer.

S.A.F. ENGINEERS VISIT AMERICAN PLANTS

Mr. Jean Brillié, chief engineer, La Soudure Autogene Francaise, Paris, and Mr. Lionel Dimitri, chief engineer of the Canadian Liquid Air, Limited, are spending the month of November on on inspection tour of the welding equipment manufacturing plants and welding installations in the United States. La Soudure Autogene Francaise is one of the largest and most important manufacturing firms in the welding industry in Europe and is known for its enterprise in developing improved apparatus and applications of the welding processes. Mr. Brillié and Mr. Dimitri have had an opportunity during their stay to visit the important research laboratories conducted by manufacturers in the welding industry and also the welding departments of some of the largest industrial concerns in the country. They were also able to attend the convention of the International Acetylene Association in Chicago and the fall meeting of the American Welding Society in Buffalo. In an interview with the editor of The Welding Engineer they have expressed themselves as being very much gratified with the fine hospitality extended to them here, which has resulted in giving them just the sort of information which they hoped to carry back to France regarding welding conditions in this country.

NEW ACETYLENE PLANT IN PHEONIX, ARIZONA

The Acetylene Products Company, El Paso, Texas, has just completed a new plant in Phoenix, Arizona, for the manufacture of compressed acetylene. W. J. Chesak is president of the company, W. W. Thornton is secretary-treasurer, J. Page Kemp is vice-president and C. F. Chesak is sales and service manager. W. H. Miller is manager of the new Phoenix plant. He is an all around practical engineer and personally superintended the installation of the plant, which is modern in every respect. It includes three fireproof buildings, 20x40, 20x30 and 20x20 in size respectively and a large gasometer. The capacity of the plant is 7,000 cubic feet a day and the arrangement is such that this capacity can be doubled. Operation began October 1st and Mr. Chesak states that the outlook in the territory is very promising since the mines, railroads and industries in Arizona are generally active and prosperous.

SALIENT FEATURES OF THE POWER AND MECHANICAL SHOW

Official Title: Fifth National Exposition of Power and Mechanical Engineering.

Date and Time: Monday, December 6, through Saturday, December 11, 1926, inclusive. Opens 12:00 noon. Closes 10:30 p. m. each day.

Place: Grand Central Palace, New York, N. Y.

Purpose: The exposition performs the service of a great clearing house of latest information about important developments in power and mechanical engineering.

Products Shown: Heat and Power Generating Apparatus, Hoisting and Conveying Equipment, Power Transmission Equipment, Machine Tools, Refrigerating Machinery, Heating and Ventilating Machinery.

Each of the above classes of mechanical equipment will convey a complete representation from all of the important manufacturers of mechanical lines and will reveal information of value to all mechanical engineers and executives in industry.

Parallel Meetings: The American Society of Mechanical Engineers will hold its annual meeting in the Engineering Societies Building, 29 West 39th Street, from December 6 through 9. The meeting of the American Society of Refrigerating Engineers will be held at the Hotel Astor from December 7 through 9.

Novel Educational Exhibits: The exposition will feature a large number of educational exhibits. Among the subjects to be included in this exhibit are models of the Flettner Rotor Ship, diagrams and models showing how piping may be designed and laid out by means of isometric drawings, and models of important power plants and important power machinery.

Motion Pictures: An elaborate program of the latest films showing engineering and industrial progress will be displayed.

Attendance and Admission: 84,599 engineering and industrial executives visited the previous exposition in December, 1925. Admission is by invitation.

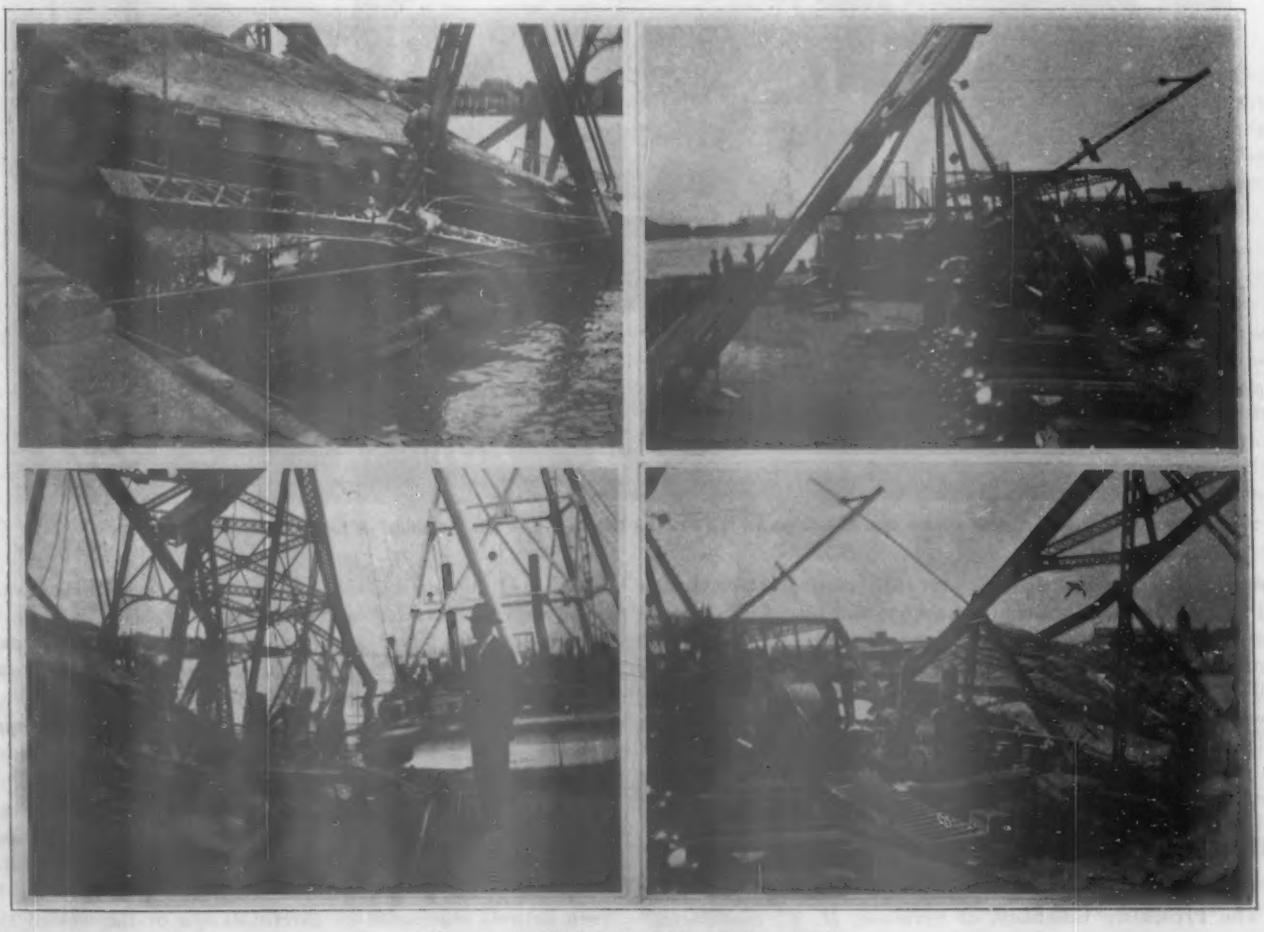
Size: The Fifth Exposition will include exhibits of five hundred manufácturers and will occupy four floors of the Grand Central Palace, the largest exposition of its kind held in this country.

Advisory Board: In the conduct of the exposition the management is assisted by an Advisory Board of outstanding consulting engineers and officers of The American Society of Mechanical Engineers, the American Society of Refrigerating Engineers, the American Society of Heating and Ventilating Engineers, the National Electric Light Association and the National Association of Stationary Engineers.

CUTTING TORCH IS USED TO REMOVE BROKEN BRIDGE

A few months ago a big steamer rammed the Webster Street bridge, which connected the city of Oakland and Alameda, California. The bridge was so badly damaged that it was found necessary to remove and replace the entire structure.

J. W. Tilden, bridge contractor, Oakland, California, is doing this herculean piece of work and the important part being played by this demolition work is of interest to all welders and cutters.



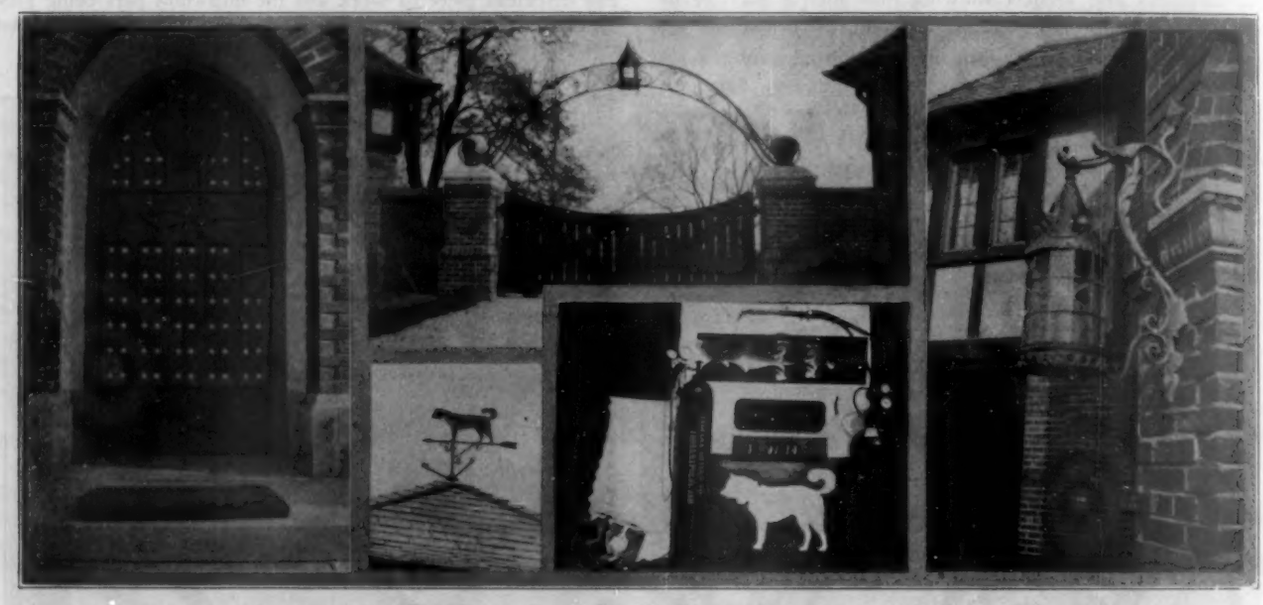
Cutting Torch Used in Removing Broken Bridge.

The Webster Street bridge is 320 feet long and spans what is called the "Estuary". This is a water-way through which the large ships carry their cargo to these Californian cities. The work is being done from a derrick barge which has a lifting capacity of 100 tons. The derrick is used to lift a portion or section of the bridge and then the cutting torch is used to cut it up and release it from its mooring. The section is then hauled to shore and cut up into charging box sizes with the oxyacetylene torch. The scrap is then shipped to the steel mills.

The accompanying illustrations show how this interesting piece of work is being done and one can readily understand from these photographs what a gigantic undertaking it is. Purox gas and equipment was used on this job.

ORNAMENTAL IRON WORK

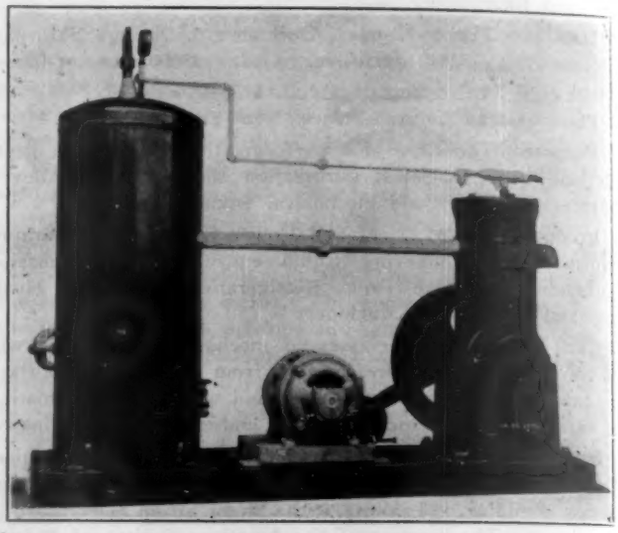
It is well known that the welding torch is an indispensable tool in the production of ornamental iron work, where the permanent assembly of an infinite variety of shapes and sizes is the regular program. The cutting torch may be said to play an equally important part in the work because it permits the immediate fabrication of any desired shape at a moment's notice. So it is not surprising that we find a member of the welding industry combining his artistic talent with the oxy-acetylene process, to produce his own ornamental iron work. The photographs shown here illustrate some of the work done by our good friend, John Brandt, of the Indiana Oxygen Company, Indianapolis. At the left is a door fitted with hinges Mr. Brandt shaped with the cutting torch. The hinges of the gate shown in the center were made in the same way, while over the gate is a more elaborate sample of his work. Below the gate is shown a rather neat weather-vane, all metal, all welded, and all cut out with the torch. Between the two tanks in the bottom picture can be seen the plates from which some of the parts were cut. At the right is a close-up of the detail of a lantern bracket, an especially attractive piece.



Ornamental Iron Work Shown Here Is the Handiwork of John Brandt, of Indianapolis.

NEW COMPRESSOR SET BUILT OF WELDED STEEL

The Prosperity Company, of Syracuse, N. Y., manufacturers of a complete line of machinery for pressing clothes, use a large number of small motor driven compressor units. The accompanying illustration shows a new unit made largely of welded steel construction.



An All Welded Compressor.

The use of the welded steel tank in place of the riveted tank formerly used, contributed to the economy of operation of the equipment. The welded tank remains permanently tight, thus eliminating air leaks as a source of power waste. Practically all riveted air tanks develop leaks around the caulked seams. Over a period of ten years, it is estimated that the power saved by the tight welded tank will practically equal the original cost of the equipment.

The Lincoln Motor is used on the new unit. This motor is also of welded steel construction, having welded steel end rings and drop forged feet welded on.

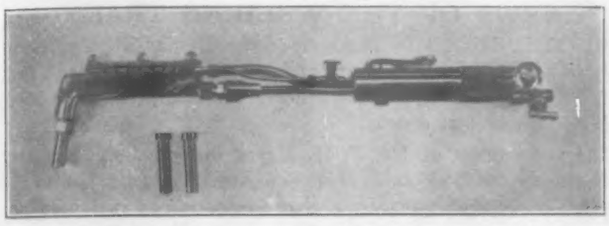
Both wood and cast iron bases have been used on small compressor units. The welded steel case is lighter for the same weight and costs somewhat less than either wood or cast iron. Vibration of the base, due to the reciprocating compressor, has been entirely eliminated by careful design of the welded steel members.

MILBURN ILLUMINATING GAS CUTTING TORCH

The Alexander Milburn Company, 1416-1428 W. Baltimore Street, Baltimore, Md., manufacturers of welding and cutting equipment, has just placed on the market a gas cutting torch for use with illuminating and by-product gases.

This torch is the result of extensive experiment and research in the utilization of a cheaper fuel, thereby reducing cutting costs materially. With city gas costing but a fraction of what other gases cost, it can readily be seen that there is a great saving in fuel gas alone.

An outstanding feature of the Milburn torch is the super-heater which heats and expands the cutting oxygen, also the preheating gases, raising the temperature of the cutting oxygen to approximately 100 degrees centigrade prior to combustion. This increases the temperature of the gases at the torch



New Milburn Cutting Torch.

tip, increases the rate of flame propagation in the burning mixture and is said to reduce the oxygen consumption from 25 per cent upwards.

A Bunsen burner, contained within the torch, burns illuminating gas which heats the cutting oxygen as it passes through a series of copper coils. This super-heater is announced as an exclusive Milburn feature.

According to officials of the Milburn company the heated and expanded oxygen in conjunction with the illuminating gas gives better penetration into the metal, a narrow kerf and sharp, clean edges, speedy and smooth cutting with a notable absence of metallic slag on the underside of the cut. It does not case-harden the surfaces cut—in fact, leaves them in practically the same state as the original steel.

Heavy plate and slabs, risers of steel castings, structural shapes, gates, billets and general steel foundry work are efficiently and economically cut with this torch. The torch operates on city gas or natural gas, which, due to its availability and low cost, minimizes the cost of operation and also affords a high degree of safety.

The torch is ruggedly constructed of bronze forgings and specially drawn tubing. The high pressure cutting oxygen is controlled by a thumb valve which remains fixed in either open or closed position. The arrangement of the gas tubes gives the torch great transverse strength. It is substantially built, well balanced and easy to handle. The torch is 21 inches in length and is supplied with a complete range of tips for light, medium and heavy cutting.

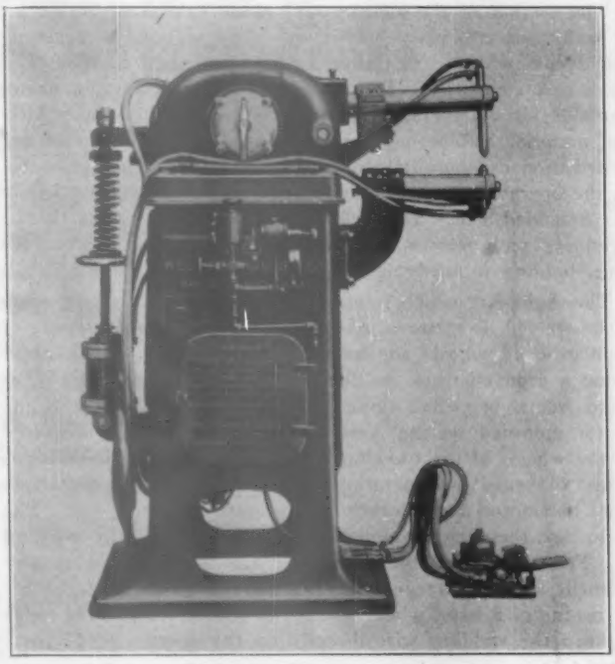
GIBB AIR OPERATED SPOT WELDER

A new high speed air operated spot welder has just been announced by the Gibb Welding Machines Company, Bay City, Michigan.

Attempts to increase speed on a hand or foot operated spot welder have frequently resulted in poor welds, owing to the personal equation varying the length of time in the making of a weld. Although heat and pressure remained constant the time element changed more or less with each weld. In addition, speed on a manually operated spot welder where there is large production has been accompanied by fatigue.

It is claimed that the air operated spot welder insures uniformity in heat, pressure and time and as a result, uniformity in welds. The operation by air is almost instantaneous. The slightest pressure at the air valve operates the machine, so that girls can operate it without the slightest fatigue, and production has been increased in some cases from thirty to ninety per cent.

One concern placed an order for six of these machines, basing their requirements on their experience with production of manually operated machines, and found that four



Air Operated Spot Welder.

machines took care of their entire production. The chief value in the high speed air operated spot welder is on sheet metal of 18 gauge and heavier, as on this work not only is fatigue eliminated but increased speed possible. On the lighter gauges, while the air operation eliminates fatigue there is no advantage in speed.

BOOKLET ON WELDING COSTS

The Chicago Steel & Wire Company, Chicago, Illinois, have recently published a little booklet designed to show the fallacy of attempting to save money on arc welding operations through the use of poorly selected wire simply because it costs a few cents per pound less. The booklet points out that the labor of laying down a pound of deposited material usually costs four times as much as the welding wire itself. Attention is called to the fact that electric welding imposes a severe nervous strain on the man who doing the work, which accounts for the fact that the average welder is depositing metal during only forty to sixty per cent of the time he is on the payroll. The rest of the time he is making various efforts to relieve the nervous fatigue of his work. That is held up as the principal objection to using common wire. It is granted that it is possible to make a weld with any kind of wire, but the strain on the operator is so great that the cost of the welding operation is out of all proportion. Pennies are saved in the office, at the expense of dollars in the shop. One example of relative costs is given to illustrate the method of computing the cost of welding and then computing the cost per pound of welding, using different grades of wire with varying degrees of weldability.

WELDING TANK SEAMS AUTOMATICALLY

The welding of longitudinal seams on tank drums or pipe is being successfully performed by a special tool designed by the Westinghouse Electric & Manufacturing Company. This tool, which will hold material of any length up to and including 8 feet, and from 10 inches to 40 inches in diameter, consists essentially of a traveling Auto Arc and a suitable cast steel framework for carrying the Auto Arc and for holding the material in place.

The section of the pipe or tank drum that is to be welded is easily put into place between the two sections of a clamping device, which is in the form of an extended arm balanced by a cast steel base. The lower half of the clamping device contains air cylinders, and a copper backing-up strip. After the material has been placed in proper position so that full penetration can be obtained when the Auto Arc passes across it, the operator throws a handle located at the extreme left of the extended arm. This releases the air which raises the air cylinders and presses the copper backing strip against the pipe, holding it firmly in place.

The Auto Arc which is placed at the beginning of the seam to be welded, is mounted on a traveling carriage consisting of four grooved wheels similar to a trolley wheel, which move along a grooved track on the extended arm of the tool. The Auto Arc is propelled along this track by means of a ¾ hp. motor mounted on the Auto Arc base, and which is geared to the wheels of the traveling carriage. When the operator is ready to begin the operation he merely throws a switch to start the motor and another one to start the Auto Arc. The Auto Arc then moves along the seam, automatically welding it. The motion of the Auto Arc can be reversed at any moment and any irregularities in the seam can be cared for by means of a hand wheel which the operator regulates so as to keep the welding wire directly on the seam.

With this automatic seam welder, tank drums of 16 gauge up to ⅜ inch in thickness can be welded at speeds from 14 to 25 inches per minute.

ENDRESS TORCHES TO BE MADE ON DESIGNS BROUGHT FROM SWITZERLAND

The Endress Manufacturing Company, Cortland, New York, is now getting well settled in new manufacturing quarters and getting into production on Endress oxy-acetylene welding and cutting torches, generators and regulators. The torches and generators are both of the low pressure type. The equipment has been made in Switzerland for several years and is one of the leading makes of apparatus in Europe. The Endress Company have recently secured the rights to manufacture and sell it in North and South America. Mr. Eberhard, Superintendent, has just recently returned from quite an extended trip in Switzerland, where he visited the plant in which the equipment is manufactured.

One of the principle features of the torch is the mixing chamber, which has been designed to effect maximum economy in gas consumption. Another feature is the interchangeability of welding and cutting hose, making it possible to use one handle for different classes of work.

The officers of the company are: F. J. Potter, President and Treasurer; Othmar K. Marti, Vice-President, and Mrs. F. J. Potter, Secretary.

G. P. A. LUNCH DRAWS INTERESTING SPEAKERS

At the weekly luncheon of the Gas Products Association, which was held at the City Club, Chicago, on Tuesday, October 19th, a departure was made from the usual informal program in order to give those in attendance at the luncheon an opportunity to hear from a couple of distinguished guests.

Mr. D. M. Perrill of the Sheet Steel Trade Extension Committee made a short talk on the subject of the work of the committee, calling attention particularly to the fact that increase in the demand for sheet metal products automatically created greater demand for welding equipment and supplies since practically all sheet metal fabrication involves the use of at least one of the several welding processes.

Mr. A. L. West, Managing Director of West's Welding Works, Sydney, Australia, commented on the advance in the application of welding which he had become acquainted with as a result of his visit in America. He mentioned several important processes which had come to his attention in the course of his travels here and which he hoped to be able to put to good use on his return to Australia.

NEWS OF THE WELDING TRADE

Mr. E. L. Mills, sales manager of the Bastian-Blessing Company has just returned from an extended trip to the Western Coast and states that he has found considerable activity in the welding line throughout that district.

The appointment of Mr. F. H. Meyer formerly sales manager of the American Welding & Mfg. Company, Warren, Ohio, to the position of general manager to that Company has just been announced. Mr. H. R. Lewis has been appointed as sales manager in Mr. Meyer's place.

A recent bulletin of the New York Academy of Sciences calls attention to the A. Cressy Morrison prize offered for the best thesis appearing with the principal source of energy of the sun. This prize has been renewed and will be awarded in December 1926.

Mr. Evan J. Parker formerly of the Morgan Engineering Works, Alliance, Ohio, has joined the forces of the Northen Engineering Works and will have charge of the sales promotion division.

The Central Steel and Wire Company, Chicago and Detroit, have finished the erection of a two story addition to their warehouse at 5001 Bellvue Av., Detroit, Mich.

Mr. P. A. Fransson who until recently has been connected with the Engineering Department of the Winfield Electric Machine Co. Warren, Ohio, recently joined the Engineering Dept. of the Agnew Electric Welder Co., Milford, Mich.

A department for the manufacture of welded smoke stacks has been established by the American Welding Engineering Co. Middletown, Ohio.

A new welding shop in Chicago is the Anchor Welding Service, 4715 West Chicago Ave. which has recently been incorporated and will conduct a job welding business.

It is reported that a two story building will soon be erected for the Marine Electric Welding Company, 29 Broadway, New York City.

The Lincoln Steel Company of Chicago have moved their general offices from 2320 W. 58th St. to 229 W. Illinois Street where larger quarters are maintained and more attention can be given to the production of their line of Koro welding electrodes.

It is reported that the Oxweld Railroad Service Company, Chicago, are planning two one story buildings to be erected at Germantown Ave. and Clarissa St. Philadelphia, Pa.

Mr. Wm. E. Hooper formerly of the Purox Company, Cleveland office recently accepted a position as sales manager for the Aluminum Fix Co. Cleveland.

The Tolbert-Efurd Welding & Machine Company was recently incorporated at Shreveport, La., as a general welding and Machine works.

It is reported that Mr. D. J. Will formerly manager of the California Compressed Gas Co., Oakland, Calif., has recently resigned to become associated with the Stewart Oxygen Company of San Francisco.

SWEDOX

WELDING RODS, WIRES and ELECTRODES

SWEDOX Welding Rods and Wires, differing widely in chemical and physical properties, have one common quality. Each brand is made for a particular welding requirement.

When you consider the care that must be exercised in the selection of metal for different construction requirements, it becomes apparent that equal care is necessary in selecting filler material for welding the joints in these constructions.

The SWEDOX line has been developed so as to furnish on each welding job the welding wire which will enable the welder to get the most satisfactory result. There is a SWEDOX wire for your work. Try it, and you'll know why SWEDOX customers come back.

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DETROIT, MICH.
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Lincoln 6780

Main Warehouses and General Offices, Central Steel & Wire Co., Chicago.

The Horseless Carriage of '98 was a success —*in '98*

Past success is no argument for tomorrow. You know from accumulated experience that the successful policies of yesterday are soon made obsolete by the ever-changing demands of business.

For continued success you must have a dependable source of pertinent information. You must keep abreast of developments. You must follow the trend of your field in every particular.

Imperative demand for this information has created the Business Papers, such as the one you are now reading. Their primary function is to gather the news of the profession which they cover and then to select and present that which is important, in such a way as to best serve you.

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This paper can render you an invaluable service. Read it regularly and gain full benefit from the information it carries.

A.B.P.

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Do You Know The Combination?

If yours is a general repair shop, you have to do both drilling and grinding, but you don't need to buy two separate tools. The WODACK Combination Portable Electric Drill and Grinder will handle both jobs and save money for you. It's a tool you need.

"Electric Tool Facts" tells all about it. Send for your copy.

Wodack Electric Tool Corporation
63 S. JEFFERSON ST., CHICAGO, ILL.

"WODACK"
Combination Portable
Electric Drill and Grinder
Patented Nov. 1, 1921

Classified Ads

Help Wanted—75c per line, minimum 4 lines.

Jobs Wanted—4 lines free.

Other Ads—$1.00 per line, minimum 4 lines.

Counted 8 words to line. Add 6 words for keyed address.

Acetylene Welder of both R. R. and Industrial work, also 5 years selling experience, desires permanent position. Address A. W. Y., care The Welding Engineer.

For Sale—Service rights on WK and WC Prest-O-Lite cylinders. Large or small quantities. Alfred E. Corp, 40 Mathewson St., Providence, R. I.

Generators for Sale—1 Davis-Bournonville acetylene generator, Serial 13588, capacity 200 cubic feet of 1¼x⅜ carbide. 1 Davis-Bournonville acetylene generator, Serial 13569, capacity 100 cubic feet of 1¼x⅜ carbide. Both of above are in excellent operating condition and will be sold to the first party making a reasonable offer for same. The Kirk & Blum Manufacturing Company, 2846 Spring Grove Ave., Cincinnati, Ohio.

Wanted—Man competent to handle the most difficult welding jobs and capable of instructing others. Must be able to give excellent references. Write to "Oxygen Company," care Welding Engineer.

For Sale—At Birmingham, Alabama, plant 1-895-A Imperial Acetylene Generator, 50-lb. capacity, 15-lb. pressure. Weir-Kilby Corp., Cincinnati, Ohio.

REBUILT LINCOLN WELDERS

6-200 amp. motor drive 3 phase 60 cycle on trucks.
2-300 amp. motor drive 3 phase 60 cycle.
3-200 amp. motor drive D. C. 220 volts.
Our stock list shows 40 more arc welders, spot welders and butt welders.

GOODMAN ELECTRIC MACHINERY CO., 126 Green St., Newark, N. J.

IMPERIAL WELDING AND CUTTING EQUIPMENT
OXY-ACETYLENE PROCESS

New Mixing Principle

a regulator that accurately controls gases, the greatest working range ever covered by ONE torch—are exclusive IMPERIAL features.

WRITE FOR CATALOG

IMPERIAL BRASS MFG. CO.
517 S. Racine Ave. Chicago, Ill.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of The Welding Engineer and that the following is, to the best for October 1st, 1926.

State of Illinois
County of Cook, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared H. S. Card, who, having been duly sworn according to law, deposes and says that he is the business manager of the The Welding Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to writ:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, G. H. Mackenzie, Chicago, Illinois; Editor, W. W. Brathers, Evanston, Illinois; Managing Editor, H. S. Card, Chicago, Illinois; Business Manager, H. S. Card, Chicago, Illinois.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. (If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) The Welding Engineer Publishing Co., 608 So. Dearborn St., Chicago, Ill.; G. H. Mackenzie, Chicago, Illinois; M. J. Hungerford, Chicago, Illinois.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affidant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

H. S. CARD, Business Manager.

Sworn to and subscribed before me this 24th day of September, 1926.

(Seal.) William Derzbach.

(My commission expires April 7, 1927.

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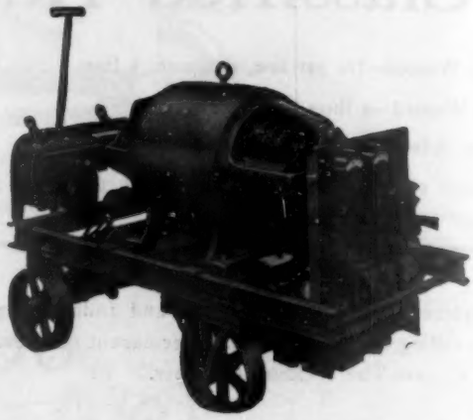

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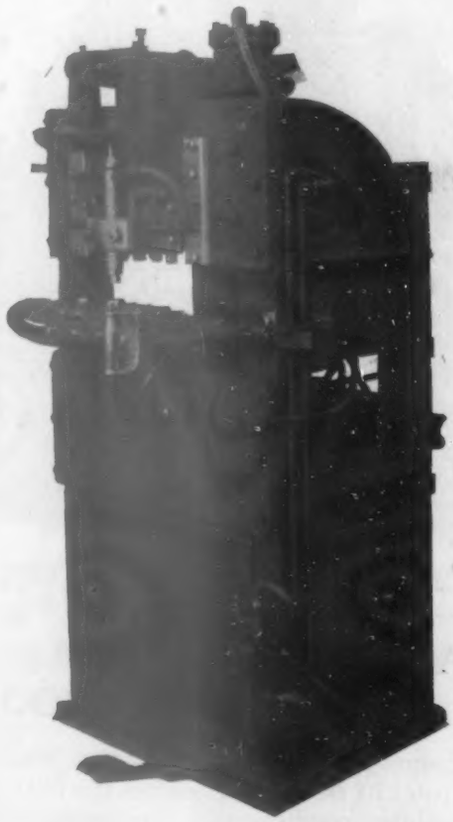

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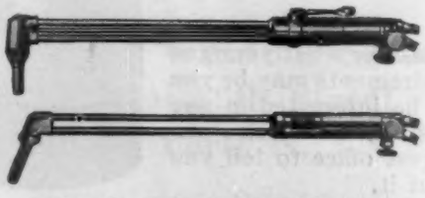

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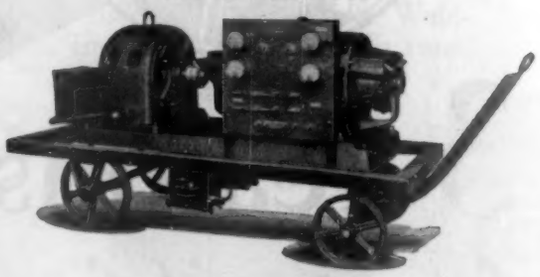

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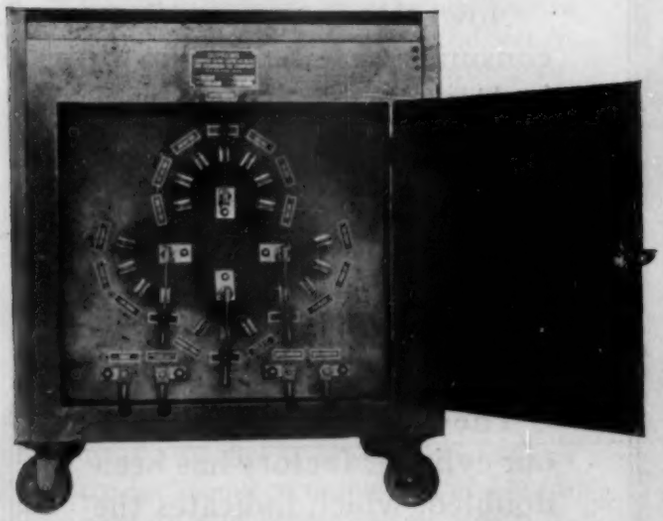

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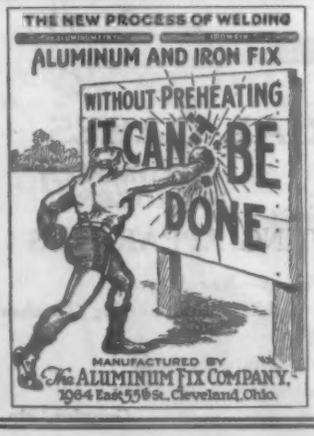

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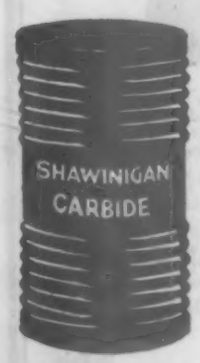

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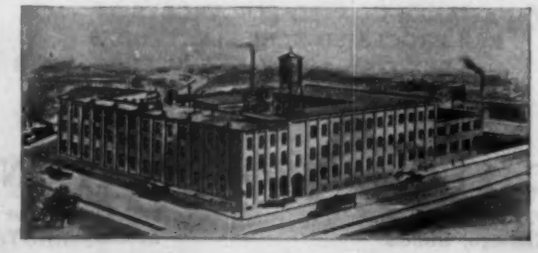

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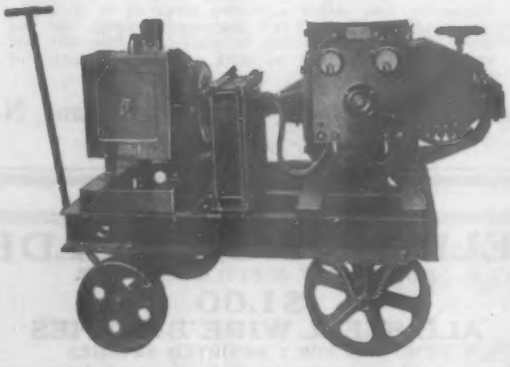

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Operation	Previously Used Material	Elkonite
Radio panels	100 welds	8,000 welds
Brass radiator shells	16,000 welds	400,000 welds
Wire to heavy metal	300 welds	12,000 welds
Motor frame assembly	15 welds	400 welds
Wire to tin plate	50,000 welds	2,500,000 welds (incomplete)
Galvanized steel wire	15,000 welds	225,000 welds
Roller bearing assembly	24,000	400,000

Elkonite Welding Electrodes remain hard, *without mushrooming*, under red heat, great pressures and heavy electric currents.

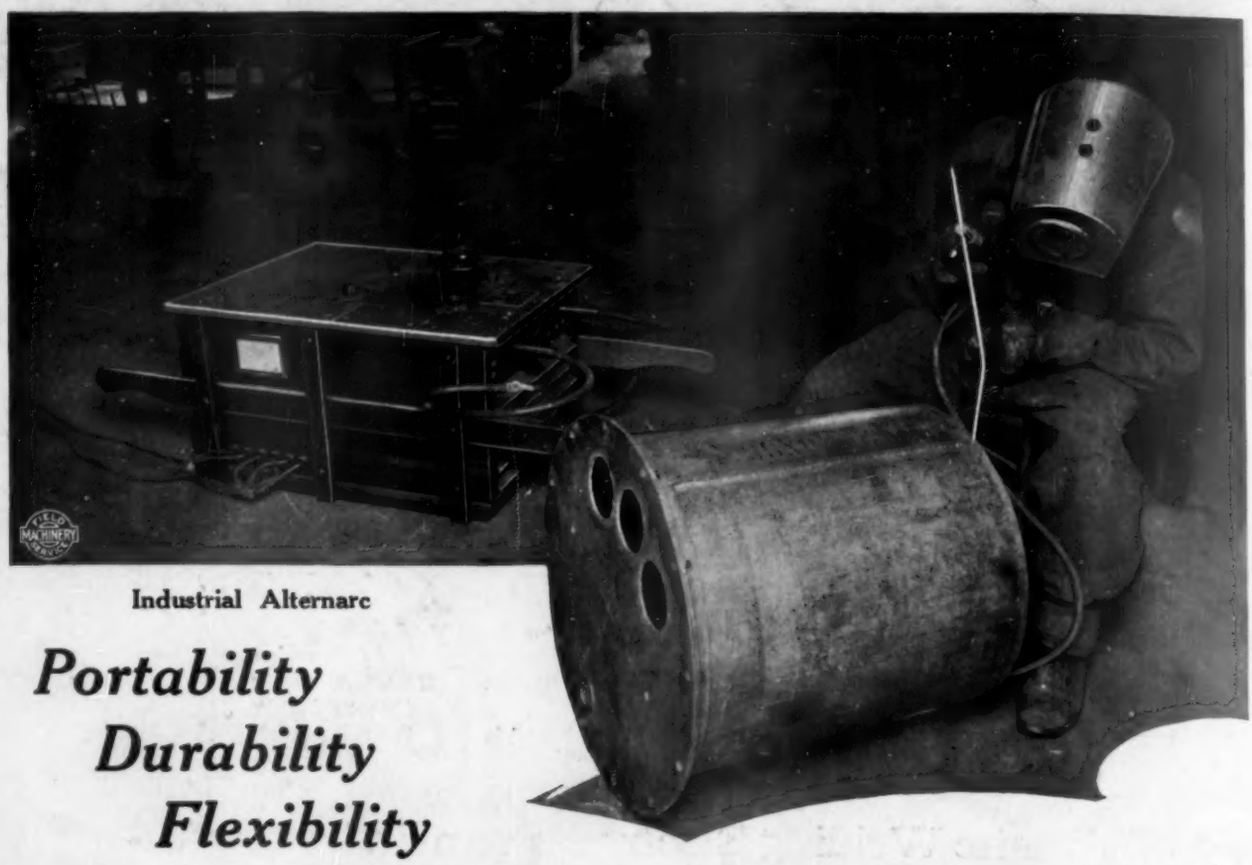
They have made the spot welding of brass, tinned iron, galvanized iron and aluminum commercially practicable.

Especially recommended for severe conditions such as hot upsetting rivets electrically, in facings for clamps for rod welding, split dies for welding steel spokes to both hub and rim of steel wheels, and all classes of flash welding.

WHEN HARD DRAWN COPPER FAILS
: : : YOU CAN DEPEND ON ELKONITE

ELKON WORKS Inc.
Subsidiary of P. R. Mallory & Co. Inc.
Weehawken, N. J.

Exclusive licensees under General Electric Co., patents dated May 28, 1925 and Sept. 1, 1925. Other patents pending to Elkon Works, Inc.



Industrial Alternarc

Portability
Durability
Flexibility

The Qualities You Want—ALTERNARC Has Them!

ALTERNARC welding outfits can be taken to any job. There is nothing to spoil or break. Some standard outfits are mounted on one man trucks. Wherever current is available you can make use of Alternarc low cost welding.

THE Alternarc system can be used for welding all ferrous metals. For heavy work or multiple operation work several machines can be grouped to form a complete unit. Among recent installations are that of a large steel corporation, which has 8 double units for structural welding, and probably the largest steel firm in the country which has 6 double arc and 3 single arc cutting transformers.

ALTERNARC construction insures long life. The outfit is stoutly built. There are no moving parts to wear out; repair and replacement bills are negligible. It is hard to imagine how an Alternarc can wear out.

ELECTRIC welding is the answer to your problem of economical production. An Alternarc machine will do the work at the lowest installation and operation cost consistent with satisfactory results. Get complete details before purchasing welding equipment.

Electric Arc Cutting and Welding Co.

152-158 Jelliff Avenue, Newark, New Jersey, U. S. A.

A. C. Metallic Arc Welding is the fastest method yet developed. People who know this are:

Federal Ship	26 Arcs	N. Y., N. H. & H. R. R.	23 Arcs
Chicago Bridge & Iron	30 Arcs	Canadian Pacific R. R.	21 Arcs
Concrete Steel	18 Arcs	Sun Shipbuilding	24 Arcs
Commonwealth Steel	14 Arcs	Royal Steel	7 Arcs
I. R. T. (N. Y. Subway)	19 Arcs	E. J. & E. R. R.	12 Arcs Cutting